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NATIONAL DAM SAFETY PROGRAM. LOWER VALLE MINES DAM (MO 30439), --ETC(U)
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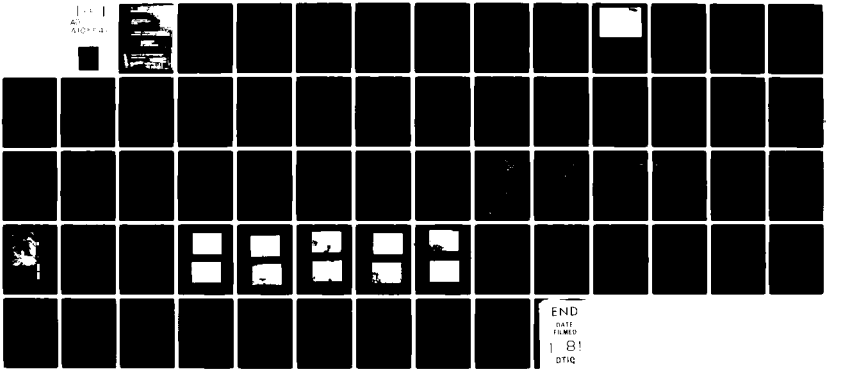

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.	

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: Lower Valle Mines Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Lower Valle Mines Dam (MO 30439).

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

a. The combined spillway capacity will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.

b. Overtopping of the dam could result in failure of the dam.

c. Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED
Chief, Engineering Division — Date: 25 FEB 1981

APPROVED BY: SIGNED
Colonel, CE, District Engineer — Date: 26 FEB 1981

LOWER VALLE MINES DAM

Jefferson County; Missouri

Missouri Inventory No. 30439

Phase I Inspection Report

National Dam Safety Program

Prepared by

Woodward-Clyde Consultants

Chicago, Illinois

Under Direction of

St Louis District, Corps of Engineers

for

Governor of Missouri

December 1980

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D. C., 20314. The purpose of a Phase I investigation is not to provide a complete evaluation of the safety of the structure nor to provide a guarantee on its future integrity. Rather the purpose of the program is to identify potentially hazardous conditions to the extent they can be identified by a visual examination. The assessment of the general condition of the dam is based upon available data (if any) and visual inspections. Detailed investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for more detailed studies. In view of the limited nature of the Phase I studies no assurance can be given that all deficiencies have been identified.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with any data which may be available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action removes the normal load on the structure, as well as the reservoir head along with seepage pressures, and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected, so that corrective action can be taken. Likewise continued care and maintenance are necessary to minimize the possibility of development of unsafe conditions.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam	Lower Valle Mines Dam
State Located	Missouri
County Located	Jefferson
Stream	Unnamed Tributary of Joachim Creek
Date of Inspection	15 August 1980

Lower Valle Mines Dam, Missouri Inventory Number 30439, was inspected by Richard Berggreen (engineering geologist), Leonard Krazynski (geotechnical engineer), and Sean Tseng (hydrologist).

The dam inspection was made following the guidelines presented in the "Recommended Guidelines for Safety Inspections of Dams". These guidelines were developed by the Chief of Engineers, US Army, Washington, D.C., with the help of federal and state agencies, professional engineering organizations, and private engineers. The resulting guidelines represent a consensus of the engineering profession. These guidelines are intended to provide for an expeditious identification of those dams which may pose hazards to human life or property, based on available data and a visual inspection. In view of the limited nature of the study, no assurance can be given that all deficiencies have been identified.

Lower Valle Mines Dam is classified as small, based on its storage capacity of 78 ac-ft. The dam is 22 ft in height. The small dam classification applies to dams between 25 and 40 ft high, or those with storage volume between 50 and 1000 ac-ft.

The St Louis District, Corps of Engineers, has classified this dam as having a high hazard potential; we concur with this classification. The estimated damage zone length extends approximately two miles downstream of the dam. Within this estimated damage zone are two improved roads, the dam and reservoir at Lake Valle, and numerous vacation and permanent dwellings on the shores of the lake. The potential for loss of life and property may be high in the event of a dam failure.

Lower Valle Mines Dam is an earth dam, densely vegetated with brush and trees. There are two spillways, the main spillway on the left or west abutment and the auxiliary spillway on the east abutment.

The visual inspection and evaluation of available data indicate Lower Valle Mines Dam is in generally fair condition. This judgment is based on the potential for overtopping, and the dense vegetation on the downstream face of the embankment. The embankment materials appear moderately erodible, but the vegetation presently offers some erosion protection. Seepage in the area beyond the toe of the dam does not appear to pose a hazard to the dam at this time. The lack of periodic inspections and maintenance on the dam is considered a deficiency. Seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" are not available which is considered a deficiency.

Hydraulic and hydrologic analyses indicate the spillways are not capable of passing the 1 percent probability-of-occurrence (100 year) flood without overtopping the dam. The 10 percent probability-of-occurrence flood will not overtop the dam. These analyses further indicate a flood of 11 percent of the Probable Maximum Flood (PMF) will overtop this embankment. (Analyses of the flood routings for the 1 percent probability-of-occurrence flood and PMF events greater than 10 percent include a hypothetical breach of the upstream Upper Valle Mines Dam, MO 30370). The PMF is defined as the flood event that may be expected to occur from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Based on the inspection of Lower Valle Mines Dam, it is recommended that further studies be conducted and remedial measures taken without undue delay to implement the following:

1. Increase spillway capacity to pass the spillway design flood of 100 percent of the PMF without overtopping the embankment. This spillway design flood is deemed appropriate because of the large number of dwellings located within about 1.5 miles downstream and a moderate erodibility of dam embankment materials in the event of significant overtopping.

The following items should be addressed as soon as practical to help avoid further deterioration of the dam or damage to the downstream structures:

2. Remove larger trees and detrimental brush from the embankment to lessen the potential development of piping paths. Removal of large trees should be done by an engineer experienced in maintenance and construction of earth dams. Indiscriminate removal of large trees could jeopardize the safety of the dam.

3. Evaluate the feasibility of implementing a practical and effective warning system to alert downstream residents in the event potentially hazardous conditions develop at this dam.

4. Make seepage and stability analyses of the dam comparable to those required in the "Recommended Guidelines for Safety Inspection of Dams". These analyses should be made for the appropriate loading conditions, including earthquake loads, and performed by a professional engineer experienced in the design and construction of earth dams.

It is also recommended that a program of periodic inspections and maintenance be implemented as soon as practical for the dam and appurtent structures. These inspections should include, but not be limited to:

1. Inspection of the slopes and crest of the dam for signs of instability such as cracking, slumping or slope deformation;

2. Monitoring seepage to identify any changes in volume of seepage water or turbidity (soil) in the flow;

3. Inspection of spillway and downstream channel for obstructions such as beaver dams or vegetation;

4. Maintenance and control of vegetation on the crest and downstream slope of the embankment.

All remedial measures should be performed under the guidance of an engineer experienced in the design and construction of earth dams.

WOODWARD-CLYDE CONSULTANTS

Richard G. Berggreen
Registered Geologist

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Vice President

OVERVIEW
LOWER VALLE MINES DAM

MISSOURI INVENTORY NUMBER 30439

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LOWER VALLE MINES DAM, MISSOURI INVENTORY NO. 30439
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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LOWER VALLE MINES DAM, MISSOURI INVENTORY NO. 30439

SECTION 1
PROJECT INFORMATION

1.1 General

a. **Authority.** The National Dam Inspection Act, Public Law 92-367, provides for a national inventory and inspection of dams throughout the United States. Pursuant to the above, an inspection was conducted of the Lower Valle Mines Dam, Missouri Inventory Number 30439.

b. **Purpose of inspection.** "The primary purpose of the Phase I investigation program is to identify expeditiously those dams which may pose hazards to human life or property... The Phase I investigation will develop an assessment of the general condition with respect to safety of the project based upon available data and a visual inspection, determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted" (Chapter 3, "Recommended Guidelines for Safety Inspection of Dams").

c. **Evaluation criteria.** The criteria used to evaluate the dam were established in the "Recommended Guidelines for Safety Inspection of Dams", Engineering Regulation No. 1110-2-106 and Engineering Circular No. 1110-2-188, "Engineering and Design National Program for Inspection of Non-Federal Dams", prepared by the Office of Chief of Engineers, Department of the Army, and "Hydrologic/Hydraulic Standards, Phase I, Safety Inspection of Non-Federal Dams", prepared by the St Louis District, Corps of Engineers (SLD). These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 Description of Project

a. **Description of dam and appurtenances.** Lower Valle Mines Dam is an earth dam constructed to impound a reservoir for use as water supply to the Valle Mining Company barite mill. The mill is currently abandoned and the lake is used for recreation, primarily fishing.

The downstream face of the dam is densely vegetated with brush and trees to 10 in. diameter. The crest of the dam is approximately 368 ft long. The downstream slope is approximately 22 ft high.

Two spillways were constructed at this facility. The main spillway is at the left abutment (as the observer faces downstream). It consists of a broad, unlined, trapezoidal notch cut into the natural soil. There is abundant growth of brush and water grasses in the spillway and immediately upstream, suggesting there is moderate potential for the spillway becoming obstructed during flood flows. There were also remnants of a beaver dam in this spillway, further indicating potential obstruction of the spillway. The low point in the main spillway is at elevation 782.5 ft, 2.7 ft below the minimum top of dam elevation.

The auxiliary spillway, located at the right abutment, is also an unlined, trapezoidal notch cut in natural soil. The spillway was moderately obstructed by weeds, but no evidence was noted of beaver activity.

Water was spilling from both spillways at the time of the visual inspection. There was a relatively heavy, but short duration rain in the early morning hours on the date of inspection, 15 August 1980.

The discharge channels below both spillways are unlined and have eroded several feet into the residual soil. Weathered bedrock is exposed in some portions of these eroded channels.

No low-level outlets were identified at this dam.

b. **Location.** The dam is located on an unnamed tributary of Joachim Creek, about 6.4 mi south of the town of Desoto, in southern Jefferson County,

Missouri. It is located in Section 6, T38N, R5E, on the USGS Vineland 7.5 minute quadrangle map. This dam is located approximately 1600 ft downstream of Upper Valle Mines Dam (MO 30370). Lake Valle Dam (MO 30438) is located approximately two miles downstream of Lower Valle Mines Dam.

c. **Size classification.** Lower Valle Mines Dam is classified small based on its storage volume of 78 ac-ft. The dam is 22 ft in height. A small dam is defined as one between 25 and 40 ft in height, or having a storage capacity between 50 and 1000 ac-ft.

d. **Hazard classification.** The St Louis District, Corps of Engineers has classified this dam as having a high hazard potential; we concur with this classification. The estimated damage zone length extends approximately two miles downstream of the dam. Within this estimated damage zone are two improved roads, the dam (MO 30438) and reservoir at Lake Valle, and numerous vacation and permanent dwellings on the shores of the lake (Photos 1, 2 and 3). The potential for loss of life and property may be high in the event of a dam failure.

e. **Ownership.** We understand that the dam is owned by Valle Mining Company, 11 South Meramec, Suite 1314, Clayton, Missouri 63105.

f. **Purpose of dam.** The dam was constructed to impound a water supply for use at the Valle Mining Company barite processing plant upstream of the lake. The plant is currently abandoned and the lake is used for recreation, primarily fishing.

g. **Design and construction history.** Information on the design and construction of the Lower Valle Mines Dam was obtained from interviews with Mr David Haverstick, superintendent for Valle Mining Company. No other records or drawings were available for this dam.

The dam was constructed in the early 1950's. It was constructed of stoney clay obtained from the valley slopes in the reservoir area. A cutoff trench was excavated to shallow bedrock and backfilled with compacted clay soil. No records are available on materials or compaction tests during construction.

h. **Normal operating procedure.** There are no operating facilities at this dam. Water surface elevation is controlled by the ungated spillways.

1.3 Pertinent Data

a. **Drainage area.** Approximately 0.17 mi^2 (not including drainage area for Upper Valle Mines Dam. Total drainage area for both dams - 0.41 mi^2).

b. **Discharge at damsite.**

Maximum known flood at damsite	Unknown
Warm water outlet at pool elevation	N/A
Diversion tunnel low pool outlet at pool elevation	N/A
Diversion tunnel outlet at pool elevation	N/A
Gated spillway capacity at pool elevation	N/A
Gated spillway capacity at maximum pool elevation	N/A
Ungated spillway capacity at maximum pool elevation	Approximately 640 ft^3/sec
Total spillway capacity at maximum pool elevation	Approximately 640 ft^3/sec

c. **Elevation (ft above MSL).**

Top of dam	785.2 to 787.8
Maximum pool - design surcharge	N/A
Full flood control pool	N/A
Recreation pool	782.5
Spillway crest (gated)	N/A
Upstream portal invert diversion tunnel	N/A
Downstream portal invert diversion tunnel	N/A
Streambed at centerline of dam	Unknown
Maximum tailwater	N/A
Toe of dam at maximum section	763.8

d. **Reservoir.**

Length of maximum pool	1050 ft
Length of recreation pool	1000 ft
Length of flood control pool	N/A

e. **Storage (acre-feet).**

Recreation pool	54
Flood control pool	N/A
Design surcharge	N/A
Top of dam	78

f. **Reservoir surface (acres).**

Top of dam	9.5
Maximum pool	9.5
Flood control pool	N/A
Recreation pool	8.2
Spillway crest	8.2

g. **Dam.**

Type	Earth
Length	368 ft
Height	22 ft
Top width	12 ft (typical)
Side slopes	Upstream, unknown (exposed portion 2.5(H) to 1(V))
	Downstream, approximately 2.5(H) to 1(V)
Zoning	Unknown
Impervious core	None
Cutoff	Trench to shallow bedrock, backfilled with clay
Grout curtain	None

h. **Diversion and regulating tunnel.**

Type	None
Length	N/A
Closure	N/A
Access	N/A
Regulating Facilities	N/A

i. **Spillway.**

Type	Main spillway - unlined trapezoidal notch at west abutment
	Auxiliary spillway - unlined trapezoidal notch at east abutment
Length of weir	Main spillway - top width approximately 71 ft, bottom width approximately 34 ft
	Auxiliary spillway - top width approximately 53 ft, bottom width approximately 14 ft
Crest elevation	Main spillway - 782.5 ft Auxiliary spillway - 783.4 ft
Gates	None
Downstream channel	Unlined channel in residual soil with some weathered bedrock outcrops
Upstream channel	None

j. **Regulating outlets.** None

SECTION 2
ENGINEERING DATA

2.1 Design

No design drawings or records were found for this dam.

2.2 Construction

Information on the construction of Lower Valle Mines Dam was obtained from Mr David Haverstick, superintendent for Valle Mining Company.

The dam was constructed by Valle Mining Company in the early 1950's. It was constructed of residual stoney clay soil obtained from the valley slopes in the reservoir and dam area. A cutoff trench of unknown dimensions was excavated to shallow bedrock and backfilled with compacted soil. No records of materials used or compaction tests are available. Compaction was likely limited to construction equipment traffic.

2.3 Operation

The reservoir served as a water supply for the barite processing plant located upstream of the reservoir. Operations at that plant terminated in the late 1950's and the facility has been used as a recreational (fishing) lake since then.

2.4 Evaluation

a. **Availability.** The available engineering data is limited to the recollection of Mr Haverstick. No other records of engineering or construction are available.

b. **Adequacy.** The available information is insufficient to evaluate the design of Lower Valle Mines Dam.

Seepage and stability analyses comparable to the requirements of the guidelines are not on record. This is a deficiency which should be rectified. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record. These analyses should be performed by an engineer experienced in the design and construction of earth dams.

c. **Validity.** There is no reason to question the validity of the information obtained from Mr Haverstick. However, the information is quite incomplete.

2.5 Project Geology

The dam site lies on the northern flank of the Ozark structural dome. The regional dip is to the north. Bedrock in the area is mapped on the Geologic Map of Missouri (1979) as Cambrian age Potosi and Eminence dolomite formations (Fig 4). The Potosi Formation is a medium- to fine-grained, light gray dolomite and typically contains an abundance of quartz druse, characteristic of chert bearing formations. The Eminence Formation conformably overlies the Potosi Formation, is similar in appearance but contains less chert and quartz. Large caves and springs are found in the Eminence Formation in parts of Missouri. The owner's representative described a flowing spring in the area of the present reservoir, and several others in the general area. However, no evidence of solution activity or springs was noted during the visual inspection.

Two soils were identified in the vicinity of the dam. The upper soil was a light brownish-gray clayey silt (ML), apparently a loess horizon, approximately 1 to 3 ft thick. This was underlain by a dark red-brown, plastic, stoney residual clay (CL-CH), apparently a residual soil developed on the weathered dolomite bedrock. The soil contained chert and quartz druse fragments from the bedrock. This residual clay was likely the soil used in the construction of the dam. The area is mapped on the Missouri General Soils Map as Union-Goss-Gasconade-Peridge Association.

The Valle Mines-Vineland Fault Zone is mapped on the Structural Features Map of Missouri (1971) approximately 3/4 mi northeast of the damsite. This fault zone is approximately 22 mi in length, trends northwest-southeast, and is mapped as southwest side up. This fault zone, like most others in the Ozark area, is likely

Paleozoic in age, and is not considered to be in a seismically active area. The fault is not considered to pose a significant hazard to the dam.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. **General.** The field inspection of Lower Valle Mines Dam was conducted on 15 August 1980. Mr David Haverstick of Valle Mining Company met with the inspection team at the site but did not accompany them throughout the inspection.

b. **Dam.** Lower Valle Mines Dam is densely vegetated, both on the crest and on the downstream face (Photo 4). This dense vegetation obstructed some of the dam face from a thorough visual inspection. Vegetation ranges from grasses and trees on the crest to thick brush and trees on the downstream face of the dam. Roots from large trees could eventually act as piping paths through the dam embankment.

No evidence of disruption of the vertical or horizontal alignment of the dam crest was noted. No sinkhole development, excessive settlement, cracking or animal burrows were noted. There was evidence of beaver activity in the area and Mr Haverstick indicated beaver dams frequently had to be cleared from the spillway areas.

The downstream face of the dam and the area beyond the toe of the dam were irregular, and appeared to have been created by construction activities. Several ridges of what appeared to be pushed-up soil were noted at the toe, apparently remnants of borrow piles for construction. Dense vegetation obstructed much of this area.

The downstream face of the dam slopes at approximately 2.5(H) to 1(V). The upstream face was covered by the reservoir, but the exposed portion was also at a slope of 2.5(H) to 1(V). There was no erosion protection on the upstream face, but significant erosion is not expected due to the grass and tree vegetation present and the short fetch of the reservoir. Although minor gullying was noted on the downstream face, no significant erosion was noted.

The dense vegetation on the top of the dam and on the downstream face appears to offer some erosion protection. The dark red, stoney, residual clay soil (CL-CH) comprising the embankment is judged to be moderately erodible in the event of overtopping of the embankment.

Seepage was noted in an area beyond the toe of the dam (Photo 5). The seepage area supported no vegetation, and was stained red-brown, apparently by algae in the seepage water. The seepage water did not appear to be carrying any soil. The flow was estimated at ½ to 1 gal/min.

c. **Appurtenant structures.**

1. Main spillway. The main spillway is a broad roughly trapezoidal notch at the left (west) abutment. This area is densely vegetated with water grasses and brush (Photo 6). Remnants of a beaver dam were noted, indicating the spillway may be subject to obstruction during flood flows.

The relatively flat slope of the channel below the spillway and the dense vegetation in both the channel and the spillway makes assessment of the location of the controlling section difficult.

The soil in which the spillway is excavated is a stoney residual clay (Photo 7), and is judged to be moderately erodible. However, substantial erosion in the spillway is not likely to pose a hazard to the dam due to the apparently shallow depth to bedrock and distance from the maximum section of the embankment.

2. Auxiliary spillway. The auxiliary spillway is located on the right (east) abutment. It is similar to the main spillway except that it is narrower and has a slightly higher crest elevation. At the time of the visual inspection, water was flowing from both the main and auxiliary spillways.

d. **Reservoir area.** The slopes surrounding the reservoir are heavily vegetated and are not expected to supply much siltation to the impoundment, although no records concerning siltation were found. The slopes are relatively gentle, 5(H) to 1(V) or flatter, and no evidence of unstable slopes was identified during the field inspection.

Upper Valle Mines Dam (MO 30370), an abandoned tailings dam, is located approximately 1/4 mi upstream. As the mines in the area have been abandoned and the tailings have settled to the bottom of the reservoir, siltation from this reservoir is not expected to be significant. Overtopping and/or failure of this dam could jeopardize the Lower Valle Mines Dam.

e. **Downstream channel.** The downstream discharge channels below both the main and auxiliary spillways are cut into the native soils along the valley walls. The main spillway and downstream channel apparently carry larger flows as a result of lower spillway crest elevation. The channel has eroded a 2 to 4 ft deep channel, locally exposing weathered bedrock (Photo 8). At several places the channel is obstructed by brush and weeds (Photo 9).

The auxiliary spillway downstream discharge channel is less eroded and appears to occupy the channel excavated in the abutment soils with little subsequent erosion (Photo 10).

Both downstream channels are directed away from the toe of the dam and erosion in either channel is not expected to pose a significant threat to the dam.

Discharge from the dam becomes inflow to Lake Valle, approximately 1.5 mi downstream. The lake has numerous houses on its banks, as shown in Photos 2 and 3.

3.2 Evaluation

The dam appears to be in generally fair condition. No cracking, excessive settlement, horizontal or vertical displacement of the dam crest, sinkhole development, or animal burrows were noted during the visual inspection. However, dense vegetation obscured some of the dam from observation.

The dense vegetation on the face and crest is considered a deficiency as roots from large trees could eventually develop piping paths through the embankment. Vegetation and beaver dams in the spillway areas could cause obstructions during flood flows.

The embankment materials appear moderately erodible in the event of overtopping, but the vegetation will likely serve as partial erosion protection.

Erosion in the spillways and downstream channels is not likely to pose a significant hazard to the embankment due to the distance from the maximum section and shallow depth to bedrock.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

The dam has no operating facilities and there are no operating procedures in affect. The water level is controlled by the crest of the two ungated spillways.

4.2 Maintenance of Dam

No records of maintenance on this dam were found. The owner's representative indicated they experienced continued problems with beaver dams in the spillways and maintenance consisted of removing the beaver dams.

4.3 Maintenance of Operating Facilities

There are no facilities requiring operation at this dam.

4.4 Description of Any Warning System in Effect

The visual inspection did not reveal any warning system in effect at this facility.

4.5 Evaluation

There is apparently no program for periodic inspections or maintenance at this facility. This is considered a deficiency.

The feasibility of a practical warning system should be evaluated to alert downstream residents in the event potentially hazardous conditions develop during periods of heavy precipitation.

SECTION 5
HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. **Design data.** No hydrologic or hydraulic design data were available for evaluation of this dam or reservoir. Elevations and dimensions of pertinent features were field surveyed 7 August 1980. Other relevent data were estimated during the visual inspection or measured from topographic maps. The map used in the analyses is the USGS 7.5-minute quadrangle map of Vineland, Missouri (1960).

b. **Experience data.** No recorded history of rainfall, runoff, discharge, overtopping or pool stage data were found for this site.

c. **Visual observations.**

1. Watershed. The entire watershed is heavily wooded with a mixture of hardwood and softwood. Parts of the watershed are covered by second growth from past mining operations. The total watershed is approximately 0.41 square miles, of which 0.24 square miles drains into an upstream tailings impoundment (Upper Valle Mines Dam, MO 30370).

2. Reservoir. The dam and the reservoir are best described by the maps and photographs enclosed herewith. The surface area of the reservoir is approximately 8 ac.

3. Spillways. The main spillway is located at the west end of the dam (left abutment); the auxiliary spillway is at the east end. Both spillway crests are unlined, covered with grass and brush. Below the crests, both discharge channels gradually curve toward the original stream channel. As both channels are mildly sloped, the spillway crests may not serve as control sections.

4. Seepage. The magnitude of seepage through this embankment is not hydraulically significant to the overtopping potential.

d. **Overtopping potential.** A primary consideration in the evaluation of Lower Valle Mines Dam is the assessment of the potential for overtopping and consequent failure by erosion of the embankment. For the spillway at the west end (the main spillway at left abutment), high velocity discharge could cause erosion of the embankment. However, erosion at this point would not likely pose a hazard to the dam due to the distance from the maximum section. For the auxiliary spillway at the east end, high velocity is unlikely due to the hydraulic characteristics of the spillway and discharge channel. The top of dam, therefore, was chosen as the lowest portion of the dam crest adjacent to the auxiliary spillway. For the purpose of determining the overtopping potential, total spillway outflow exceeding approximately 640 ft^3/sec is considered to overtop the embankment.

Upstream of Lower Valles Mine Dam is a tailings impoundment with a total storage capacity of approximately 145 acre-ft. As per the guidelines, a multiple dams analysis was performed to evaluate Lower Valle Mines Dam. Lake Valle Dam is located approximately 1.5 miles downstream, is part of the potential damage zone, but was not included in the overtopping analysis.

The results of the analyses indicate that the one percent probability-of-occurrence flood will overtop the dam. The 10 percent probability-of-occurrence flood will not overtop the dam. For the PMF ratio floods, a flood of approximately 11 percent of the PMF will overtop the dam. These results, however, include hypothetical breaching at the upper dam for the precipitation events equal to or exceeding 11 percent of the PMF. The PMF is defined as the flood that may be expected to occur from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in this region.

Based on the multiple dams analysis, the following results were compiled assuming no erosion of the spillways or embankment:

Precipitation Event	Maximum Reservoir Elevation, ft (MSL)	Maximum Depth Over Dam, ft	Maximum Outflow, ft^3/sec	Duration of Overtopping, hrs
1% Prob*	785.9	0.7	1270	1.0
10% PMF	783.7	0	70	0
11% PMF*	785.7	0.5	1080	0.7
50% PMF*	785.8	0.6	1120	2.3
100% PMF*	786.5	1.3	2300	5.7

* Upstream dam assumed breached

As noted above, this summarized analysis for Lower Valle Mines Dam has included a hypothetical breach of Upper Valle Mines Dam (MO 30370) for those floods that will overtop the upper dam (1 percent probability and PMF events greater than 11 percent). The majority of the inflow for these flood routings at the lower dam is from the breached dam, and not overland runoff.

According to our analysis, there will be significant duration and depth of overtopping for floods greater than 50 percent of the PMF. Although excessive spillway channel erosion is not expected, the effects of overtopping will be to create a turbulent, rapid flow on the downstream face of the dam. This will likely cause erosion on the downstream face and reduce the stability of the dam. Without stability studies and tests on the embankment soils, the potential for dam failure due to erosion cannot be accurately evaluated. It is felt, however, that failure of the dam, in its present condition, could occur for a flood approaching 100 percent PMF magnitude.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. **Visual observations.** The visual inspection of Lower Valle Mines Dam revealed no evidence of horizontal or vertical displacement of the dam crest alignment. No cracking, settlement, slides, sinkholes or other signs of instability were observed. The seepage noted at the toe of the dam does not appear to pose a hazard to the stability of the embankment at this time.

b. **Design and construction data.** No design or construction data relating to structural stability of the dam were available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available. This is considered a deficiency.

c. **Operating records.** No operating records were available for this dam.

d. **Post construction changes.** The lack of drawings or construction reports preclude identification of post construction changes. However, Mr Haverstick did not disclose any post-construction changes. The only apparent change is the growth of brush and small to large trees on the embankment.

e. **Seismic stability.** The dam is located in Seismic Zone 2, to which the guidelines assign a moderate damage potential. Since no static stability analysis of the dam is available for review, the seismic stability cannot be evaluated. The gravelly clay character of the embankment indicates the dam should not be subject to liquefaction during a seismic event.

SECTION 7
ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

a. **Safety.** Based on the results of the visual inspection and evaluation of available data, Lower Valle Mines Dam is judged to be in generally fair condition. This judgment is based on the potential overtopping of the embankment by a storm equivalent to 11 percent of the PMF or greater, the congested and potentially obstructed condition of the spillways, and the dense vegetation on the downstream face of the dam. At present, erosion in the spillways and discharge channels does not appear to pose a hazard to the safety of the dam. Seepage in the area beyond the toe of the dam does not appear to pose a hazard to the dam. Seepage and stability analyses comparable to the requirements of the guidelines are not available. This is considered a deficiency.

The outflow expected by a flood of greater than 50 percent of the PMF may inundate some of the structures shown in Photos 1, 2 and 3 in Appendix A. The degree of inundation and damage to these structures is unknown without analyzing the competency of Lake Valle Dam (MO 30438) to pass the outflow from Lower Valle Mines Dam and the runoff from the drainage area of Lake Valle Dam.

b. **Adequacy of information.** The lack of stability and seepage analyses for this dam, as recommended in the guidelines, precludes an evaluation of the structural and seismic stability of the dam. This is a deficiency that should be rectified. These analyses should be conducted by an engineer experienced in the design and construction of earth dams.

c. **Urgency.** The deficiencies described in this report could affect the long term stability of this dam. Corrective actions as described in Section 7.2b should be initiated without undue delay as the two spillways do not pass the recommended spillway design flood.

d. **Necessity for Phase II.** In accordance with the "Recommended Guidelines for Safety Inspections of Dams", the subject investigation was a minimum study. This study revealed that additional in-depth investigations are needed to complete the assessment of the safety of the dam. Those investigations which should be performed without undue delay are described in Section 7.2b. It is our understanding from discussions with the St Louis District that any additional investigations are the responsibility of the owner.

7.2 Remedial Measures

a. **Alternatives.** There are several general options which may be considered to reduce the possibility of dam failure or to diminish the harmful consequences of such a failure. Some of these options are:

1. Remove the dam, or breach it to prevent storage of water.

2. Increase the height of dam and/or spillway size to pass the PMF without overtopping the dam.

3. Purchase downstream land that would be adversely impacted by dam failure and restrict human occupancy.

4. Provide a highly reliable flood warning system (generally does not prevent damage but diminishes the chances for loss of life).

b. **Recommendations.** Based on our inspection of Lower Valle Mines Dam, it is recommended that a further study be conducted and remedial measures taken without undue delay to implement the following:

1. As the spillway will only pass less than 11 percent of the PMF, it is recommended that the spillway capacity be increased to pass 100 percent of the PMF without overtopping the embankment. This spillway design flood is deemed appropriate because of the large number of dwellings located approximately 1.5 miles downstream, and the moderate erodibility of the dam embankment materials in the event of significant overtopping.

The following items should be addressed as soon as practical to help avoid further deterioration of the dam or damage to the downstream structures:

2. Remove larger trees and detrimental brush from the embankment to lessen potential future development of piping paths. Removal of large trees should be done by an engineer experienced in maintenance and construction of earth dams. Indiscriminate removal of large trees could jeopardize the safety of the dam.

3. Evaluate the feasibility of implementing a practical and effective warning system to alert downstream residents, should potentially hazardous conditions develop at this dam.

4. Make seepage and stability analyses of the dam comparable to those required in the "Recommended Guidelines for Safety Inspection of Dams". These analyses should be made for the appropriate loading conditions including earthquake loads.

c. Operation and maintenance procedures. It is recommended that a program of periodic inspections be implemented as soon as practical for the dam and appurtenant structures. These inspections should include but not be limited to:

1. Inspection of the slopes for signs of instability such as cracking, slumping or slope deformation.

2. Monitoring seepage to identify any changes in volume of seepage water or turbidity (soil) in the flow.

3. Inspection of spillways and downstream channels for obstructions such as vegetation or beaver dams.

4. Control of vegetation on the crest and downstream slope of the embankment.

All remedial measures and inspections should be performed under the guidance of an engineer experienced in the design and maintenance of earth dams.

Records should be kept of the inspections performed and any necessary maintenance.

REFERENCES

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Department of the Army, Office of the Chief of Engineers, 1979, ER 1110-2-106, "National Program of Inspection of Non-Federal Dams".

Hydrologic Engineering Center, US Army Corps of Engineers, 1978, "Flood Hydrograph Package (HEC-1) Users Manual for Dam Safety Investigations".

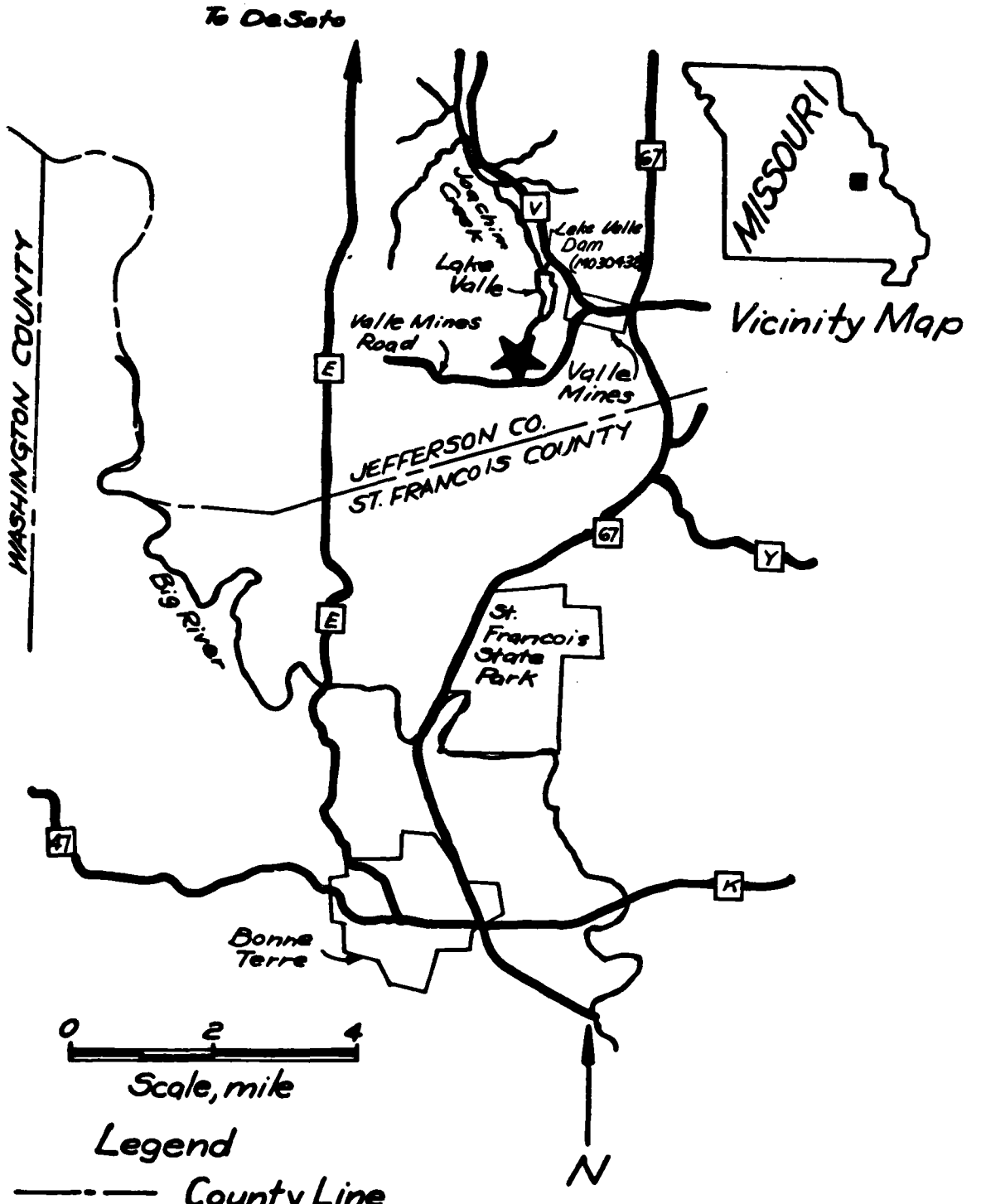
McCracken, Mary H., 1971, Structural Features Map of Missouri: Missouri Geological Survey, Scale 1:500,000.

Missouri Geological Survey, 1979, Geologic Map of Missouri: Missouri Geological Survey, Scale 1:500,000.

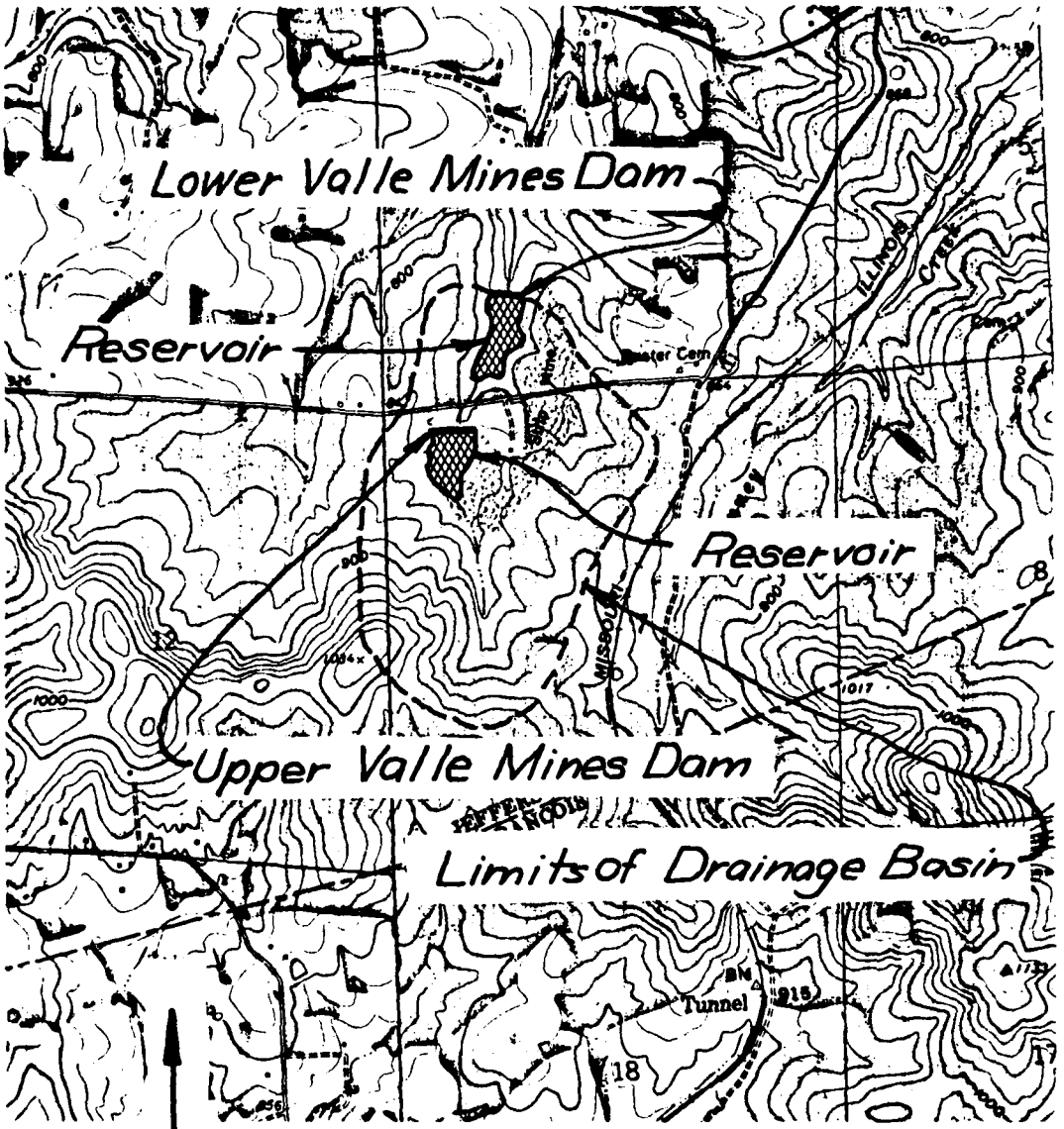
St Louis District, US Army Corps of Engineers, 1979, "Hydrologic/Hydraulic Standards, Phase I Safety Inspection of Non-Federal Dams".

US Department of Commerce, US Weather Bureau, 1956, "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Durations of 6, 12, 24 and 48 Hours," Hydrometeorological Report No. 33.

US Soil Conservation Service, 1971, "National Engineering Handbook," Section 4, Hydrology, 1971.

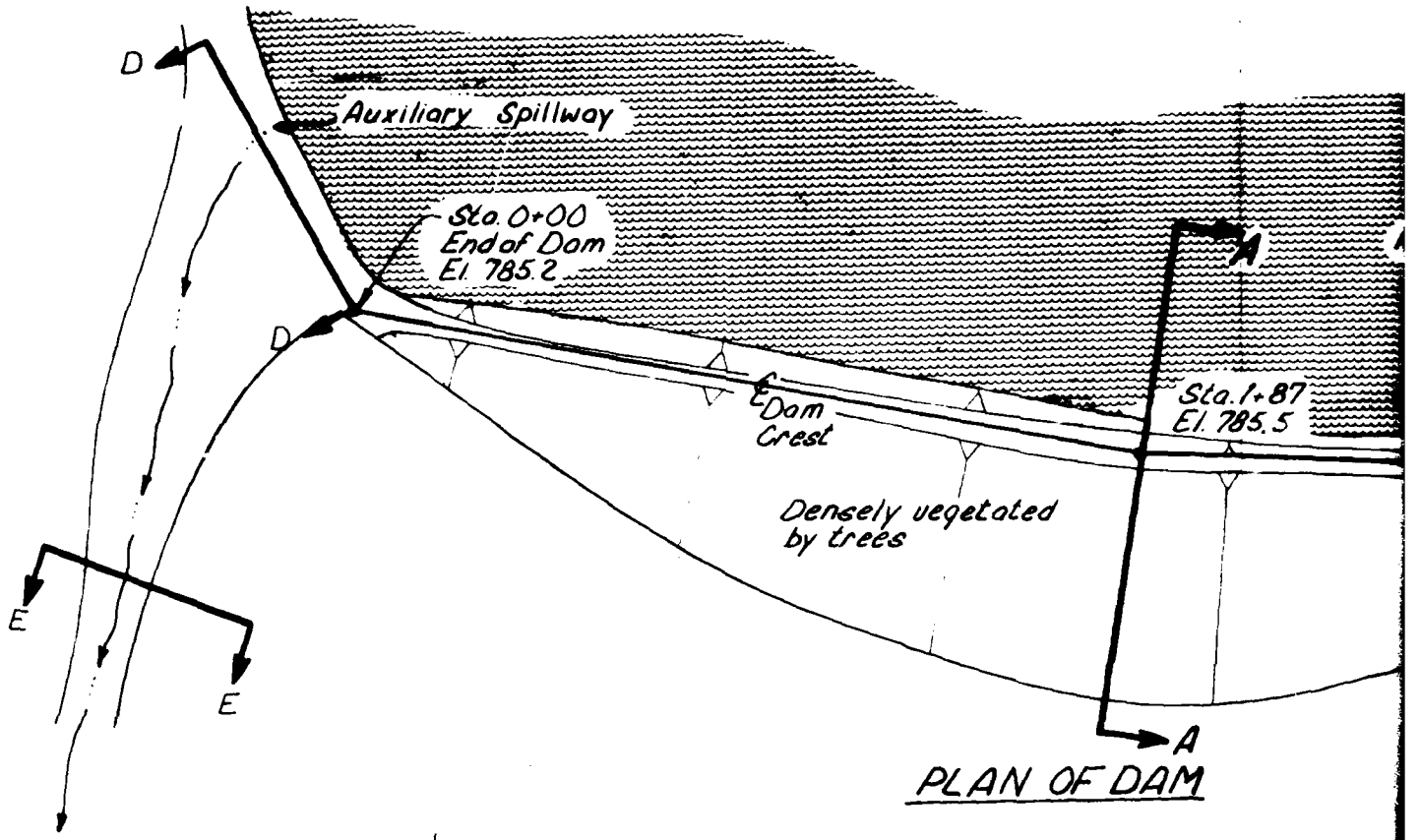


SITE LOCATION MAP	
LOWER VALLE MINES DAM	
MO 30439	Fig. 1

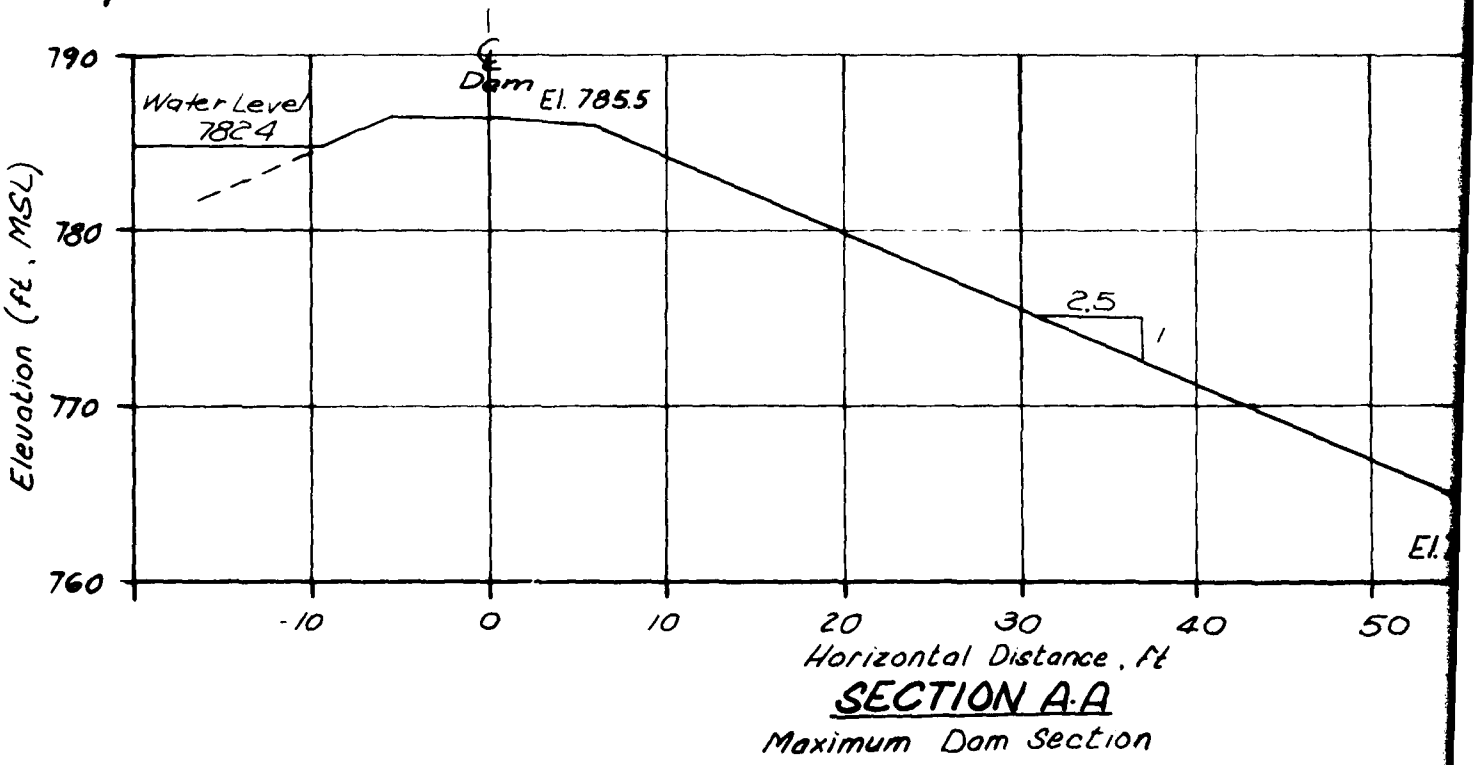


Note: Topography from USGS Vineland, Missouri 7.5 minute quadrangle map (1960)

DRAINAGE BASIN AND SITE TOPOGRAPHY	
LOWER VALLE MINES DAM	
MO 30439	Fig. 2

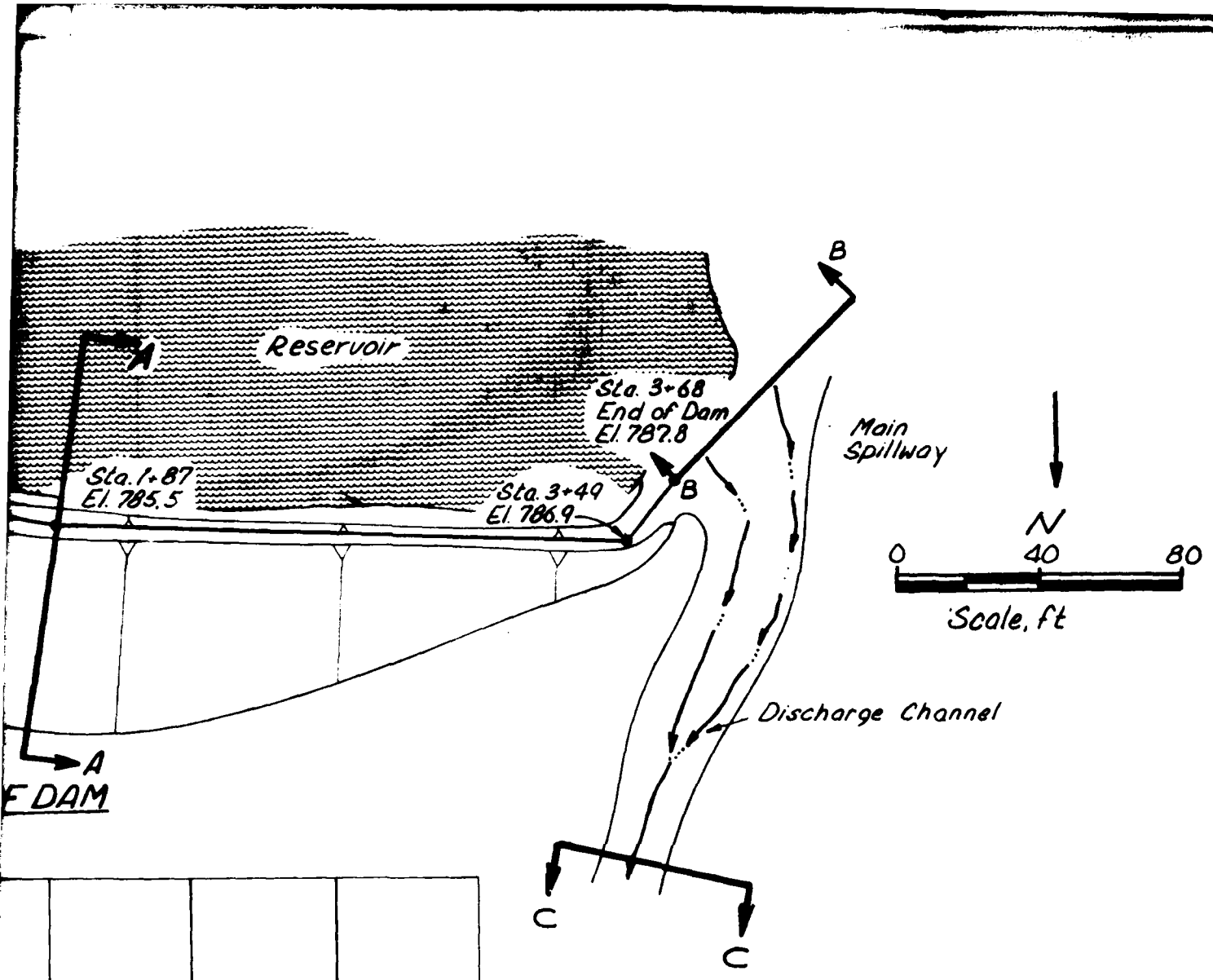


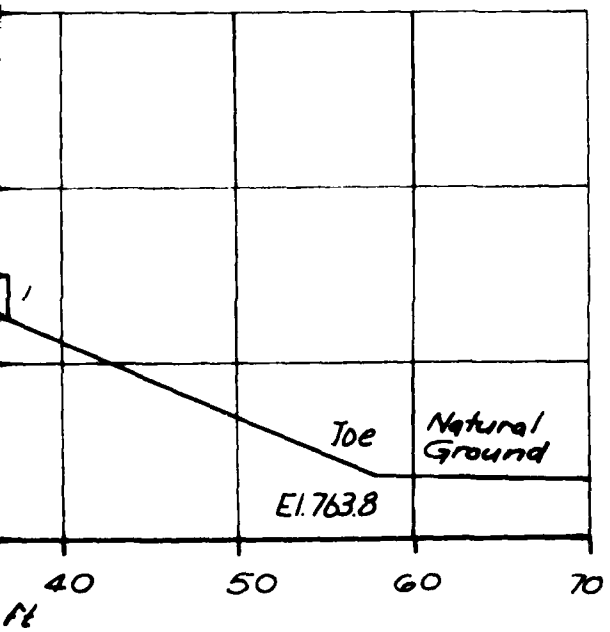
PLAN OF DAM



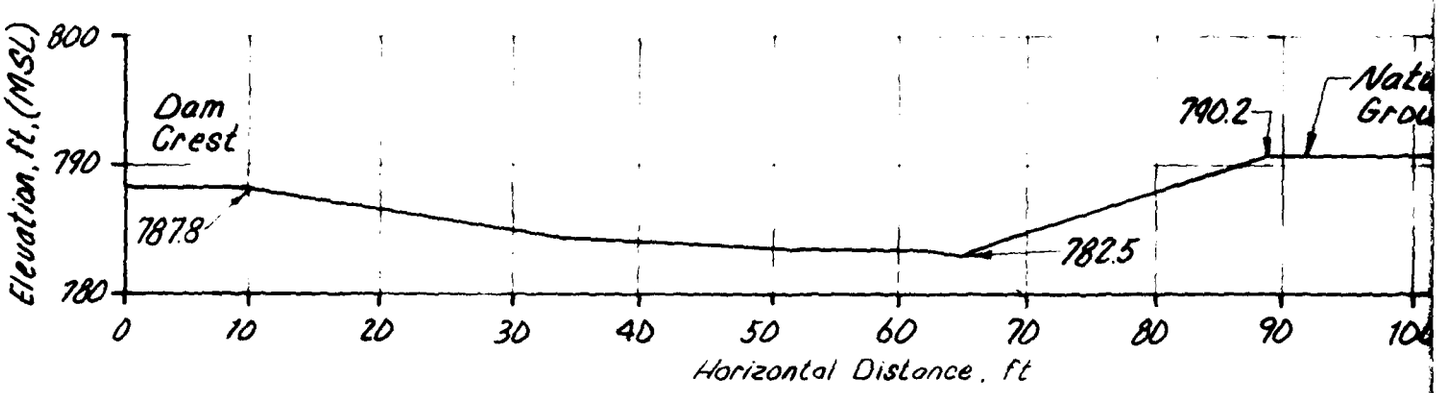
SECTION A-A

Maximum Dam Section



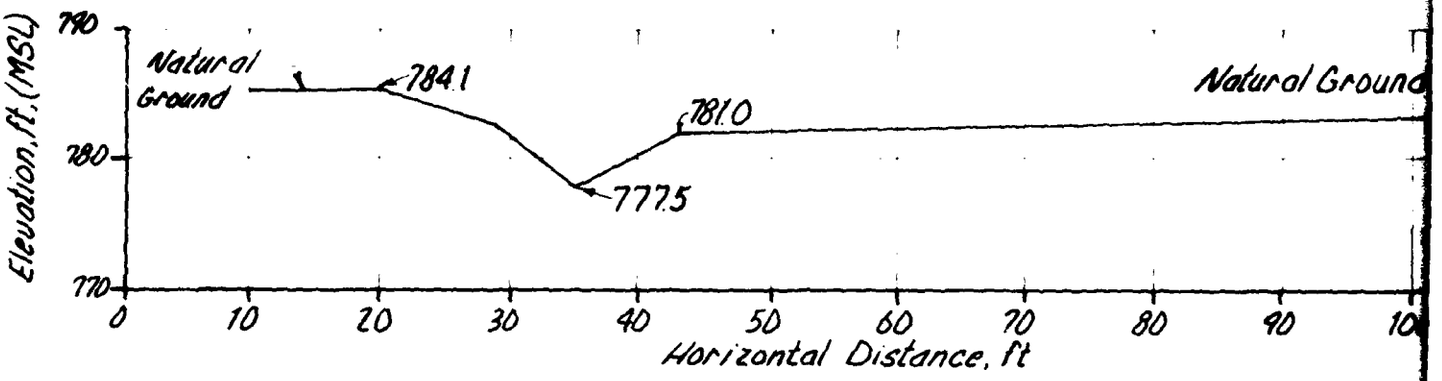


PLAN AND MAXIMUM SECTION OF DAM	
LOWER VALLE MINES DAM	
MO 30439	Fig. 3-A



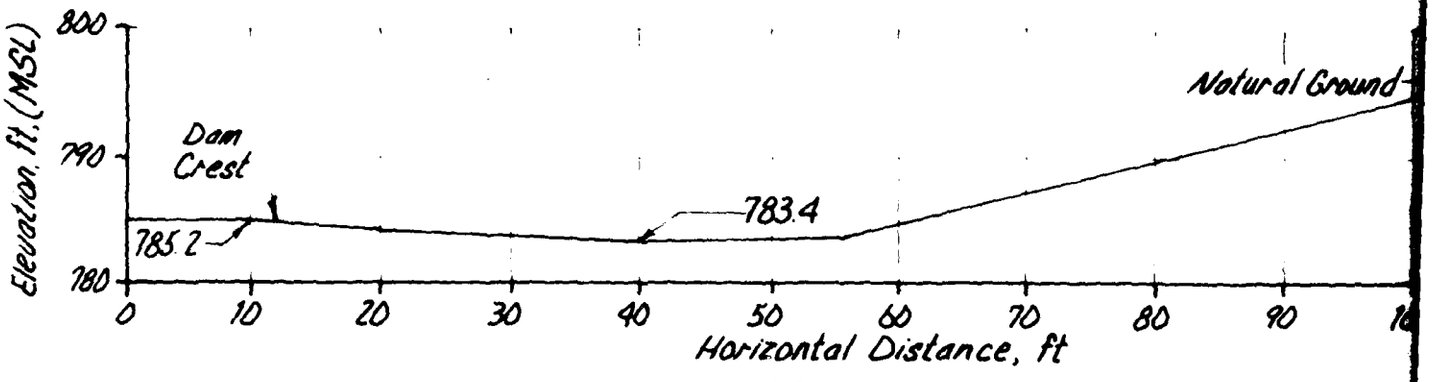
SECTION B-B

Main Spillway



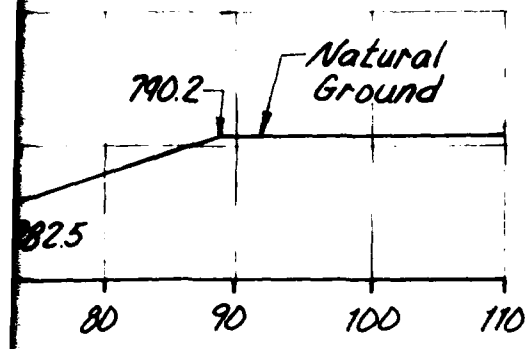
SECTION C-C

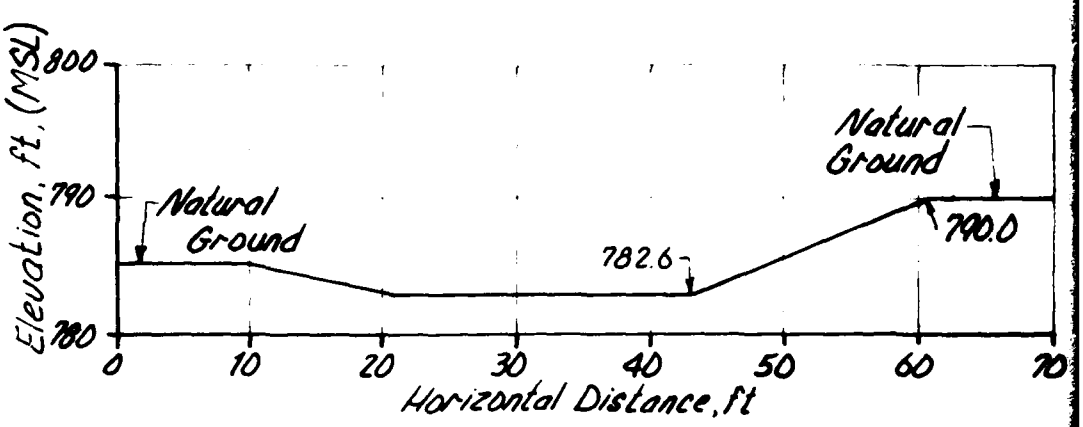
Downstream Channel of Main Spillway



SECTION D-D

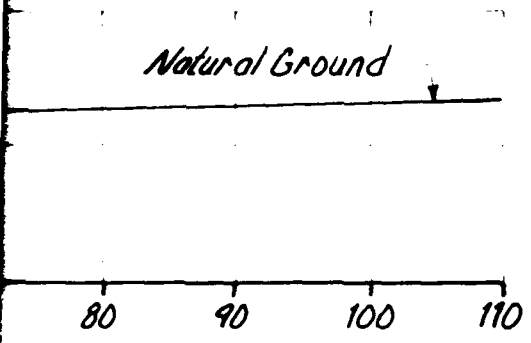
Auxiliary Spillway

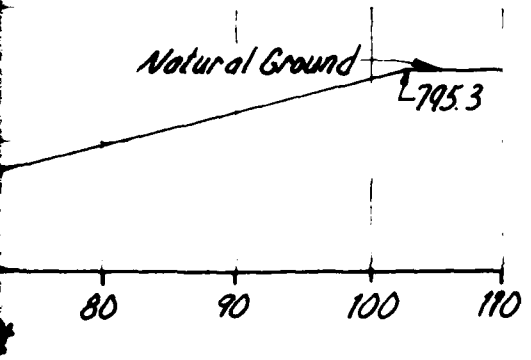




SECTION E-E

Downstream Channel of Auxiliary Spillway





SECTIONS OF SPILLWAYS AND DOWNSTREAM CHANNELS	
LOWER VALLE MINES DAM	
MO 30439	Fig. 38

N

0 10 20

Scale, mile

Legend

Ojc	Smithville Formation Powell Dolomite Cotter Dolomite Jefferson City Dolomite
Or	Roubidoux Formation
	Gasconade Dolomite Gunter Sandstone Member
Cep	Eminence Dolomite
	Potosi Dolomite
	Derby-Doerun Dolomite
	Davis Formation
	Bonneterre Formation Whetstone Creek Member Sullivan Siltstone Member
	Reagan Sandstone
	Lamotte Sandstone
	Diabase (dikes and sills)
	St. Francois Mountains Intrusive Suite
	St. Francois Mountains Volcanic Supergroup

REGIONAL GEOLOGIC MAP

LOWER VALLE MINES DAM

MO 30439 | Fig. 4

APPENDIX A

Photographs

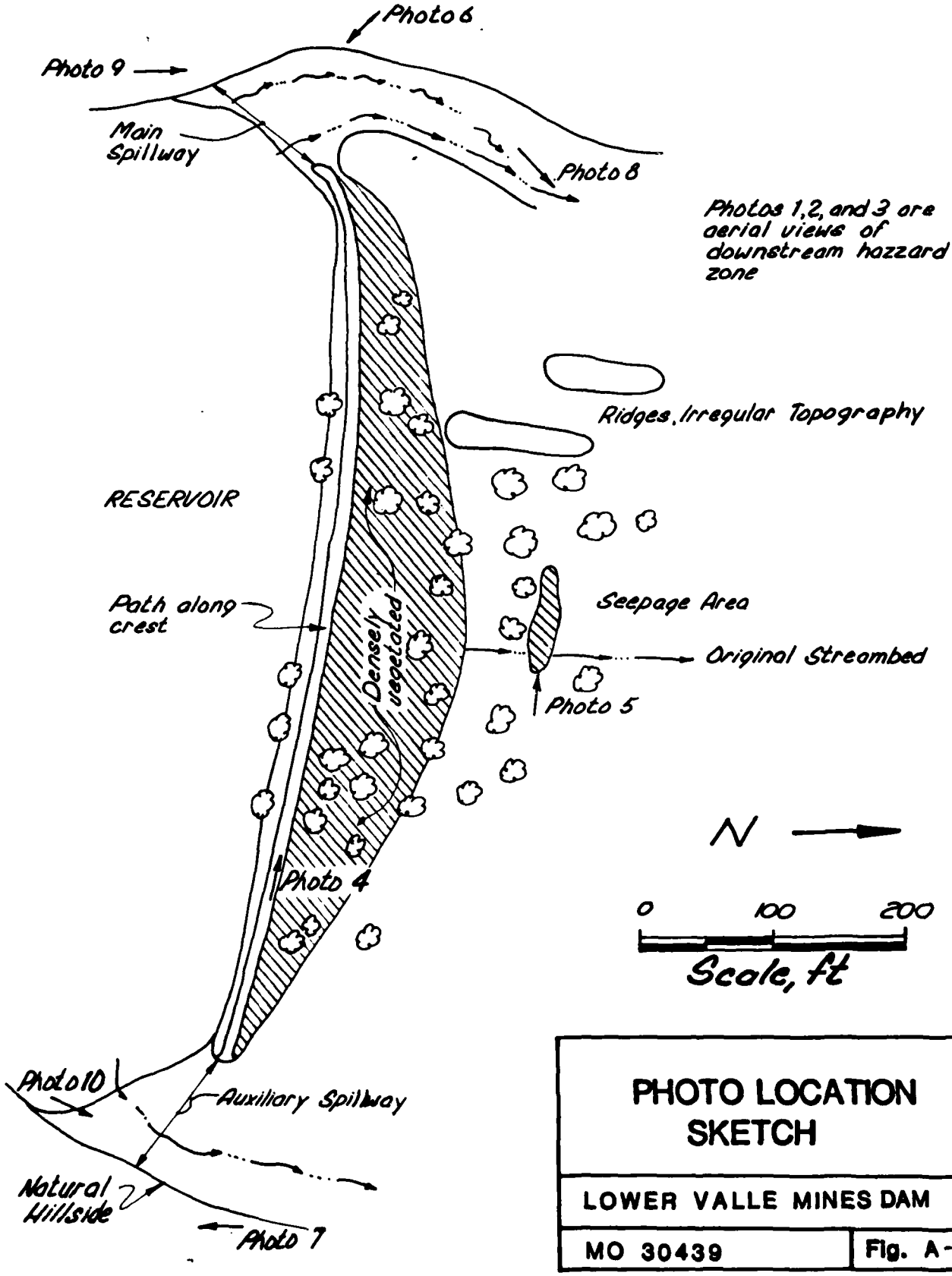


PHOTO LOCATION SKETCH

LOWER VALLE MINES DAM

MO 30439 | Fig. A-1

1. Downstream hazards below Lower Valle Mines Dam. Dam is out of picture to the right. Looking east.

2. Downstream hazards below Lower Valle Mines Dam. Community of Valle Lake. Lower Valle Mines Dam is approximately 1.5 miles upstream, to the right. Looking east.

3. Valle Lake Dam (not a part of project), approximately 2 miles downstream from Lower Valle Mines Dam. Looking southeast.

4. Vegetation on crest of dam. Impoundment is to the left. Note dense vegetation on downstream face, to the right. Looking west.

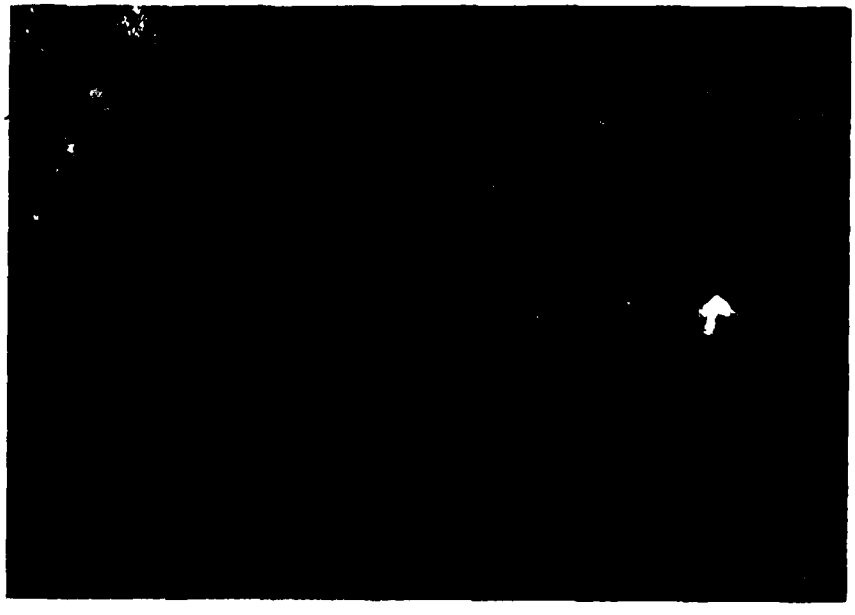
5. Seepage area beyond toe of dam. Red color appears to be algae growth, not transported soil. Clipboard at left for scale.

6. Main spillway at left (west) abutment. Note obstruction by grasses and brush. Looking southeast.

7. Stoney clay soil exposed in cuts at both abutments. Abundance of gravel probably due to washing away fine soil fraction.

8. Channel eroded into natural soil along downstream channel below main spillway. Looking north (downstream).

9. Downstream channel below main spillway. Note obstructions consisting of brush and small trees. Looking north (downstream).



10. Downstream channel below auxiliary spillway. Less obstructed than channel below main spillway. Looking north (downstream).

APPENDIX B

Hydraulic/Hydrologic Data and Analyses

APPENDIX B
Hydraulic/Hydrologic Data and Analyses

B.1 Procedures

a. General. The hydraulic/hydrologic analyses were performed using the "HEC-1, Dam Safety Version (1 Apr 80)" computer program. The inflow hydrographs were developed for various precipitation events by applying them to a synthetic unit hydrograph. The inflow hydrographs were subsequently routed through the reservoir and appurtenant structures by the modified Puls reservoir routing option.

b. Precipitation events. The Probable Maximum Precipitation (PMP) and the 1 and 10 percent probability-of-occurrence events were used in the analyses. The total rainfall and corresponding distributions for the 1 and 10 percent probability events were provided by the St. Louis District, Corps of Engineers. The Probable Maximum Precipitation was determined from regional curves prepared by the US Weather Bureau (Hydrometeorological Report Number 33, 1956, reprinted 1967).

c. Unit hydrograph. The Soil Conservation Services (SCS) Dimensionless Unit Hydrograph method (National Engineering Handbook, Section 4, Hydrology, 1971) was used in the analysis. This method was selected because of its simplicity, applicability to drainage areas less than 10 mi^2, and its easy availability within the HEC-1 computer program.

The watershed lag time was computed using the SCS "curve number method" by an empirical relationship as follows:

$$L = \frac{\ell^{0.8}\,(s+1)^{0.7}}{1900\,Y^{0.5}} \qquad \text{(Equation 15-4)}$$

where: L = lag in hours
ℓ = hydraulic length of the watershed in feet
$s = \frac{1000}{CN} - 10$ where CN = hydrologic soil curve number
Y = average watershed land slope in percent.

This empirical relationship accounts for the soil cover, average watershed slope and hydraulic length.

With the lag time thus computed, another empirical relationship is used to compute the time of concentration as follows:

$$T_C = \frac{L}{0.6} \qquad \text{(Equation 15-3)}$$

where: T_C = time of concentration in hours

L = lag in hours.

Subsequent to the computation of the time of concentration, the unit hydrograph duration was estimated utilizing the following relationship:

$$\Delta D = 0.133 T_c \qquad \text{(Equation 16-12)}$$

where: ΔD = duration of unit excess rainfall
T_c = time of concentration in hours.

The final interval was selected to provide at least three discharge ordinates prior to the peak discharge ordinate of the unit hydrograph. For this dam, a time interval of 10 minutes was used.

d. Infiltration losses. The infiltration losses were computed by the HEC-1 computer program internally using the SCS curve number method. The curve numbers were established taking into consideration the variables of: (a) antecedent moisture condition, (b) hydrologic soil group classification, (c) degree of development, (d) vegetative cover and (e) present land usage in the watershed.

Antecedent moisture condition III (AMC III) was used for the PMF events and AMC II was used for the 1 and 10 percent probability events, in accordance with the guidelines. The remaining variables are defined in the SCS procedure and judgements in their selection were made on the basis of visual field inspection.

e. Starting elevations. Reservoir starting water surface elevations for this dam were set as follows:

(1) 1 and 10 percent probability events - main spillway crest elevation

(2) Probable Maximum Storm - main spillway crest elevation

f. Spillway Rating Curve. The HEC-2 computer program was used to compute the spillway rating curve using discharge channel cross sections and conveyance characteristics.

B.2 Pertinent Data

a. Drainage area. 0.17 mi^2 excluding drainage area of upstream dam
0.41 mi^2 including drainage area of upstream dam

b. Storm duration. A unit hydrograph was developed by the SCS method option of HEC-1 program. The design storm of 48 hours duration was divided into 10 minute intervals in order to develop the inflow hydrograph.

c. Lag time. 0.56 hrs

d. Hydrologic soil group. C

e. SCS curve numbers.

1. For PMF- AMC III - Curve Number 87
2. For 1 and 10 percent probability-of-occurrence events AMC II - Curve Number 73

f. Storage. Elevation-area data were developed by planimetering areas at various elevation contours on the USGS Vineland, Missouri (1960) 7.5 minute quadrangle map. The data were entered on the $A and $E cards so that the HEC-1 program could compute storage volumes.

g. Outflow over dam crest. As the profile of the dam crest is irregular, flow over the crest was computed according to the "Flow Over Non-Level Dam Crest" supplement to the HEC-1 User's Manual. The crest length-elevation data and hydraulic constants were entered on the $D, $L, and $V cards.

h. Outflow capacity. The elevation discharge relationships of two spillways, one at each end of the dam, were developed from cross-sections of the spillways and downstream channels using the HEC-II step backwater profile program. Then the two rating curves were combined to produce the total discharge - elevation data which were entered on the Y4 and Y5 cards for the HEC-I program.

i. Reservoir elevations. For the 50 and 100 percent of the PMF events, and the 1 and 10 percent probability-of-occurrence events, the starting reservoir elevation was 782.5 ft, the main spillway crest elevation.

B.3 Results

The results of the analyses as well as the input values to the HEC-1 program follow in this Appendix. Only the results summaries are included, not the intermediate output. Complete copies of the HEC-1 output are available in the project files.

```
**********  ********************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  01 APR 80
**********  ********************
     1          A1       DAM NO. 30370 - UPPER VALLES MINE DAM, JEFFERSON COUNTY, MISSOURI.
     2          A2       WOODWARD-CLYDE CONSULTANTS, HOUSTON JOB 79CH009.
     3          A3       PROBABLE MAXIMUM FLOODS (PMF) ANALYSIS.
     4          B    288       0      10      -0      -0      -0      -0      -0      -0      -0
     5          B1     5
     6          J      1       2       1
     7          J1   .50    1.00
     8          K      0    QIN-1                                                    1
     9          K1   UPPER VALLES MINE DAM INFLOW COMPUTATION, PMF RATIO FLOODS.
    10          M      1       2    0.24                               1.0
    11          P      0     26.     102     120     130     140
    12          T                                                      -1      -87             0.08
    13          M2           0.53
    14          X     -1    -.05       5
    15          K      1    DAM-1                                                    1
    16          K1   UPPER VALLES MINE DAM FLOOD ROUTING, PMF RATIO FLOODS.
    17          V                                      1       1
    18          V1     1                                                -827.5
    19          SA    0.     6.8    11.5     13.     15.5    23.6
    20          SE   790.    820.   825.6   827.5    830.    840.
    21          SS 827.5      29     2.8     1.5
    22          SD 827.7     2.5     1.5
    23          SL    0.    450.    550.    665.    775.    935.
    24          SV 827.7    829.   828.5    829.   829.5    830.
    25          SR  10.0     0.5    815.     1.0   827.5   827.7
    26          K      0    Q-IN2                                                    1
    27          K1   LOWER VALLES MINE DAM(EARTH) INFLOW COMPUTATION, PMF RATIO FLOODS.
    28          M      1       2    0.17                               1.0
    29          P      0     26.     102     120     130     140
    30          T                                                      -1      -87             0.08
    31          M2           0.56
    32          X     -1    -.05       5
    33          K      2    Q-IN2
    34          K      1    DAM2                                                     1
    35          K1   LOWER VALLES MINE DAM(EARTH) FLOOD ROUTING, PMF RATIO FLOODS.
    36          V                                      1       1
    37          V1     1                                                -782.5      -1
    38          V4 782.5   783.4    784.   784.5    785.   785.5    786.    787.    788.    789.
    39          V4   790.    791.    792.
    40          V5    0.     30.    120.    295.    520.    810.   1105.   1780.   2710.   4140.
    41          V5 6150.   8150.  10300.
    42          SR    0.      1.     8.2     9.5    10.2
    43          SE   765.    780.   782.5   785.2    800.
    44          SS 782.5
    45          SD 785.2     2.8     1.5
    46          SL    0.    185.    245.    300.    350.    360.    370.
    47          SV 785.2   785.5    786.   786.5    787.   787.5    788.
    48          K     99
```

Note: Per response to Corps of Engineers Guidelines, the contour interval for computing reservoir storage has been recomputed. Correct input is shown on page B4a. Storage values and overtopping analysis were unaltered.

```
HEC-1 FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  01 APR 80
RUN  DATE= 12 DEC 83
     TIME= 09:35:43
```

DAM NO. 30370 - UPPER VALLES MINE DAM, JEFFERSON COUNTY, MISSOURI.
WOODWARD-CLYDE CONSULTANTS, HOUSTON JOB 79CH009.
PROBABLE MAXIMUM FLOODS (PMF) ANALYSIS.

JOB SPECIFICATION

NW	NWR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	-0	-0	-0	-0	-0	5	-0
			JOPER	NHT	LROPT	TRACE			
			5	-0	-0	-0			

SURFACE AREA=	0.	1.	3.	7.	12.	13.	16.	24.
CAPACITY=	0.	3.	21.	68.	119.	142.	178.	372.
ELEVATION=	790.	800.	810.	820.	826.	828.	830.	840.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
827.7	29.0	2.8	1.5	-0.	-0.	-0.	-0.

DAM DATA

TOPEL	COQD	EXPD	DAMWID
827.7	2.5	1.5	-0.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
10.	.50	815.00	1.00	827.50	827.70

BEGIN DAM FAILURE AT 16.00 HOURS

PEAK OUTFLOW IS 1299. AT TIME 17.00 HOURS

BEGIN DAM FAILURE AT 15.00 HOURS

PEAK OUTFLOW IS 1315. AT TIME 16.00 HOURS

SURFACE AREA=	0.	1.	7.	8.	10.	12.	18.
CAPACITY=	0.	1.	35.	54.	78.	130.	279.
ELEVATION=	765.	770.	780.	783.	785.	790.	800.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
782.5	-0.	-0.	-0.	-0.	-0.	-0.	-0.

DAM DATA

TOPEL	COQD	EXPD	DAMWID
785.2	2.6	1.5	-0.

PEAK OUTFLOW IS 1117. AT TIME 40.33 HOURS

B4a

Input Data
Various PMF Events
Lower Valle Mines
MO 30439

TIME. 13.23.49

DAM NO. 30370 - UPPER VALLES MINE DAM, JEFFERSON COUNTY, MISSOURI.
WOODWARD-CLYDE CONSULTANTS, HOUSTON JOB 79CH009.
PROBABLE MAXIMUM FLOODS (PMF) ANALYSIS.

JOB SPECIFICATION

NQ	NMR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	-0	-0	-0	-0	-0	-0	-0

JOPER	NHT	LROPT	TRACE
5	-0	-0	-0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 2 LRTIO= 1
RTIOS= .50 1.00

SUB-AREA RUNOFF COMPUTATION

UPPER VALLES MINE DAM INFLOW COMPUTATION, PMF RATIO FLOODS.

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
QIN=1	0	-0	-0	-0	-0	1	-0	-0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.24	-0.	.24	1.00	-0.	-0	-0	-0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.	20.00	102.00	120.00	130.00	140.00	-0.	-0.

LOSS DATA

CRVNB	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
-0	-0.	-0.	1.00	-0.	-0.	1.00	-1.00	-87.00	-0.	.08

CURVE NO = -87.00 WETNESS = -1.00 EFFECT CN = 87.00

UNIT HYDROGRAPH DATA

TC= -0. LAG= .53

RECESSION DATA

STRTQ= -1.00 QRCSN= -.05 RTIOR= 5.00

UNIT HYDROGRAPH 18 END OF PERIOD ORDINATES, TC= -0. HOURS, LAG= .53 VOL= 1.00

31.	104.	177.	187.	154.	100.	62.	41.	26.	17.
11.	7.	4.	3.	2.	1.	1.	0.		

END-OF-PERIOD FLOW

HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.10	1	.00	.00	.00	0.	1.02	.10	145	.03	.02	.00	3.
1.01	.20	2	.00	.00	.00	0.	1.02	.20	146	.03	.02	.00	6.
1.01	.30	3	.00	.00	.00	0.	1.02	.30	147	.03	.02	.00	10.
1.01	.40	4	.00	.00	.00	0.	1.02	.40	148	.03	.02	.00	14.
1.01	.50	5	.00	.00	.00	0.	1.02	.50	149	.03	.03	.00	17.
1.01	1.00	6	.00	.00	.00	0.	1.02	1.00	150	.03	.03	.00	19.
1.01	1.10	7	.00	.00	.00	0.	1.02	1.10	151	.03	.03	.00	21.

B5

Output Summary
Various PMF Events
Lower Valle Mines Dam
MO 30439

1.01	.50	5	.00	.00	.00	0.	1.02	.50	149	.03	.03	.00	17.
1.01	1.00	6	.00	.00	.00	0.	1.02	1.00	150	.03	.03	.00	18.
1.01	1.10	7	.00	.00	.00	0.	1.02	1.10	151	.03	.03	.00	21.
1.01	1.20	8	.00	.00	.00	0.	1.02	1.20	152	.03	.03	.00	22.
1.01	1.30	9	.00	.00	.00	0.	1.02	1.30	153	.03	.03	.00	22.
1.01	1.40	10	.00	.00	.00	0.	1.02	1.40	154	.03	.03	.00	23.
1.01	1.50	11	.00	.00	.00	0.	1.02	1.50	155	.03	.03	.00	23.
1.01	2.00	12	.00	.00	.00	0.	1.02	2.00	156	.03	.03	.00	23.
1.01	2.10	13	.00	.00	.00	0.	1.02	2.10	157	.03	.03	.00	23.
1.01	2.20	14	.00	.00	.00	0.	1.02	2.20	158	.03	.03	.00	23.
1.01	2.30	15	.00	.00	.00	0.	1.02	2.30	159	.03	.03	.00	24.
1.01	2.40	16	.00	.00	.00	0.	1.02	2.40	160	.03	.03	.00	24.
1.01	2.50	17	.00	.00	.00	0.	1.02	2.50	161	.03	.03	.00	24.
1.01	3.00	18	.00	.00	.00	0.	1.02	3.00	162	.03	.03	.00	24.
1.01	3.10	19	.00	.00	.00	0.	1.02	3.10	163	.03	.03	.00	24.
1.01	3.20	20	.00	.00	.00	0.	1.02	3.20	164	.03	.03	.00	24.
1.01	3.30	21	.00	.00	.00	0.	1.02	3.30	165	.03	.03	.00	24.
1.01	3.40	22	.00	.00	.00	0.	1.02	3.40	166	.03	.03	.00	24.
1.01	3.50	23	.00	.00	.00	0.	1.02	3.50	167	.03	.03	.00	24.
1.01	4.00	24	.00	.00	.00	0.	1.02	4.00	168	.03	.03	.00	24.
1.01	4.10	25	.00	.00	.00	0.	1.02	4.10	169	.03	.03	.00	24.
1.01	4.20	26	.00	.00	.00	0.	1.02	4.20	170	.03	.03	.00	24.
1.01	4.30	27	.00	.00	.00	0.	1.02	4.30	171	.03	.03	.00	24.
1.01	4.40	28	.00	.00	.00	0.	1.02	4.40	172	.03	.03	.00	24.
1.01	4.50	29	.00	.00	.00	0.	1.02	4.50	173	.03	.03	.00	24.
1.01	5.00	30	.00	.00	.00	0.	1.02	5.00	174	.03	.03	.00	24.
1.01	5.10	31	.00	.00	.00	0.	1.02	5.10	175	.03	.03	.00	24.
1.01	5.20	32	.00	.00	.00	0.	1.02	5.20	176	.03	.03	.00	24.
1.01	5.30	33	.00	.00	.00	0.	1.02	5.30	177	.03	.03	.00	24.
1.01	5.40	34	.00	.00	.00	0.	1.02	5.40	178	.03	.03	.00	24.
1.01	5.50	35	.00	.00	.00	0.	1.02	5.50	179	.03	.03	.00	24.
1.01	6.00	36	.00	.00	.00	0.	1.02	6.00	180	.03	.03	.00	24.
1.01	6.10	37	.01	.00	.01	0.	1.02	6.10	181	.13	.12	.01	29.
1.01	6.20	38	.01	.00	.01	0.	1.02	6.20	182	.13	.12	.01	37.
1.01	6.30	39	.01	.00	.01	0.	1.02	6.30	183	.13	.12	.01	49.
1.01	6.40	40	.01	.00	.01	0.	1.02	6.40	184	.13	.12	.01	71.
1.01	6.50	41	.01	.00	.01	1.	1.02	6.50	185	.13	.12	.01	89.
1.01	7.00	42	.01	.00	.01	1.	1.02	7.00	186	.13	.12	.01	99.
1.01	7.10	43	.01	.00	.01	1.	1.02	7.10	187	.13	.12	.01	101.
1.01	7.20	44	.01	.00	.01	1.	1.02	7.20	188	.13	.12	.01	105.
1.01	7.30	45	.01	.00	.01	1.	1.02	7.30	189	.13	.12	.01	108.
1.01	7.40	46	.01	.00	.01	1.	1.02	7.40	190	.13	.12	.01	110.
1.01	7.50	47	.01	.00	.01	1.	1.02	7.50	191	.13	.12	.01	111.
1.01	8.00	48	.01	.00	.01	1.	1.02	8.00	192	.13	.12	.01	112.
1.01	8.10	49	.01	.00	.01	1.	1.02	8.10	193	.13	.12	.01	113.
1.01	8.20	50	.01	.00	.01	1.	1.02	8.20	194	.13	.12	.01	114.
1.01	8.30	51	.01	.00	.01	1.	1.02	8.30	195	.13	.12	.01	114.
1.01	8.40	52	.01	.00	.01	1.	1.02	8.40	196	.13	.12	.01	115.
1.01	8.50	53	.01	.00	.01	1.	1.02	8.50	197	.13	.12	.01	115.
1.01	9.00	54	.01	.00	.01	1.	1.02	9.00	198	.13	.12	.01	116.
1.01	9.10	55	.01	.00	.01	1.	1.02	9.10	199	.13	.12	.01	116.
1.01	9.20	56	.01	.00	.01	1.	1.02	9.20	200	.13	.13	.00	116.
1.01	9.30	57	.01	.00	.01	1.	1.02	9.30	201	.13	.13	.00	116.
1.01	9.40	58	.01	.00	.01	1.	1.02	9.40	202	.13	.13	.00	116.
1.01	9.50	59	.01	.00	.01	1.	1.02	9.50	203	.13	.13	.00	116.
1.01	10.00	60	.01	.00	.01	1.	1.02	10.00	204	.13	.13	.00	116.
1.01	10.10	61	.01	.00	.01	1.	1.02	10.10	205	.13	.13	.00	116.
1.01	10.20	62	.01	.00	.01	1.	1.02	10.20	206	.13	.13	.00	116.
1.01	10.30	63	.01	.00	.01	1.	1.02	10.30	207	.13	.13	.00	117.
1.01	10.40	64	.01	.00	.01	1.	1.02	10.40	208	.13	.13	.00	117.
1.01	10.50	65	.01	.00	.01	1.	1.02	10.50	209	.13	.13	.00	117.
1.01	11.00	66	.01	.00	.01	1.	1.02	11.00	210	.13	.13	.00	117.
1.01	11.10	67	.01	.00	.01	1.	1.02	11.10	211	.13	.13	.00	117.
1.01	11.20	68	.01	.00	.01	1.	1.02	11.20	212	.13	.13	.00	117.

1.01	11.00	66	.01	.00	.01	1.	1.02	11.00	210	.13	.13	.00	117.
1.01	11.10	67	.01	.00	.01	1.	1.02	11.10	211	.13	.13	.00	117.
1.01	11.20	68	.01	.00	.01	1.	1.02	11.20	212	.13	.13	.00	117.
1.01	11.30	69	.01	.00	.01	1.	1.02	11.30	213	.13	.13	.00	117.
1.01	11.40	70	.01	.00	.01	2.	1.02	11.40	214	.13	.13	.00	117.
1.01	11.50	71	.01	.00	.01	2.	1.02	11.50	215	.13	.13	.00	118.
1.01	12.00	72	.01	.00	.01	2.	1.02	12.00	216	.13	.13	.00	118.
1.01	12.10	73	.03	.01	.03	2.	1.02	12.10	217	.44	.43	.01	120.
1.01	12.20	74	.03	.01	.02	3.	1.02	12.20	218	.44	.43	.01	199.
1.01	12.30	75	.03	.01	.02	4.	1.02	12.30	219	.44	.43	.01	214.
1.01	12.40	76	.03	.01	.02	6.	1.02	12.40	220	.44	.43	.01	271.
1.01	12.50	77	.03	.01	.02	7.	1.02	12.50	221	.44	.44	.01	318.
1.01	13.00	78	.03	.01	.02	8.	1.02	13.00	222	.44	.44	.01	344.
1.01	13.10	79	.04	.02	.02	9.	1.02	13.10	223	.53	.52	.01	372.
1.01	13.20	80	.04	.02	.02	11.	1.02	13.20	224	.53	.52	.01	344.
1.01	13.30	81	.04	.02	.02	12.	1.02	13.30	225	.53	.52	.01	418.
1.01	13.40	82	.04	.02	.02	14.	1.02	13.40	226	.53	.52	.01	446.
1.01	13.50	83	.04	.02	.02	15.	1.02	13.50	227	.53	.53	.01	491.
1.01	14.00	84	.04	.02	.02	16.	1.02	14.00	228	.53	.53	.00	466.
1.01	14.10	85	.05	.03	.02	17.	1.02	14.10	229	.66	.66	.01	494.
1.01	14.20	86	.05	.03	.02	19.	1.02	14.20	230	.66	.66	.01	458.
1.01	14.30	87	.05	.03	.02	21.	1.02	14.30	231	.66	.66	.00	524.
1.01	14.40	88	.05	.03	.02	23.	1.02	14.40	232	.66	.66	.00	551.
1.01	14.50	89	.05	.03	.02	24.	1.02	14.50	233	.66	.66	.00	573.
1.01	15.00	90	.05	.03	.02	26.	1.02	15.00	234	.66	.66	.00	587.
1.01	15.10	91	.05	.03	.02	27.	1.02	15.10	235	.80	.80	.00	599.
1.01	15.20	92	.08	.05	.03	28.	1.02	15.20	236	1.01	1.00	.00	603.
1.01	15.30	93	.14	.10	.04	32.	1.02	15.30	237	1.81	1.81	.01	667.
1.01	15.40	94	.39	.28	.09	46.	1.02	15.40	238	4.93	4.92	.02	898.
1.01	15.50	95	.10	.08	.02	69.	1.02	15.50	239	1.31	1.31	.00	1252.
1.01	16.00	96	.06	.05	.01	90.	1.02	16.00	240	.81	.80	.00	1630.
1.01	16.10	97	.05	.04	.01	94.	1.02	16.10	241	.62	.62	.00	1698.
1.01	16.20	98	.05	.04	.01	85.	1.02	16.20	242	.62	.62	.00	1488.
1.01	16.30	99	.05	.04	.01	69.	1.02	16.30	243	.62	.62	.00	1196.
1.01	16.40	100	.05	.04	.01	57.	1.02	16.40	244	.62	.62	.00	972.
1.01	16.50	101	.05	.04	.01	50.	1.02	16.50	245	.62	.62	.00	833.
1.01	17.00	102	.05	.04	.01	45.	1.02	17.00	246	.62	.62	.00	736.
1.01	17.10	103	.04	.03	.01	42.	1.02	17.10	247	.49	.49	.00	670.
1.01	17.20	104	.04	.03	.01	39.	1.02	17.20	248	.49	.49	.00	624.
1.01	17.30	105	.04	.03	.01	36.	1.02	17.30	249	.49	.49	.00	578.
1.01	17.40	106	.04	.03	.01	34.	1.02	17.40	250	.49	.49	.00	545.
1.01	17.50	107	.04	.03	.01	32.	1.02	17.50	251	.49	.49	.00	509.
1.01	18.00	108	.04	.03	.01	31.	1.02	18.00	252	.49	.49	.00	488.
1.01	18.10	109	.00	.00	.00	30.	1.02	18.10	253	.04	.04	.00	466.
1.01	18.20	110	.00	.00	.00	26.	1.02	18.20	254	.04	.04	.00	409.
1.01	18.30	111	.00	.00	.00	21.	1.02	18.30	255	.04	.04	.00	326.
1.01	18.40	112	.00	.00	.00	15.	1.02	18.40	256	.04	.04	.00	220.
1.01	18.50	113	.00	.00	.00	11.	1.02	18.50	257	.04	.04	.00	164.
1.01	19.00	114	.00	.00	.00	8.	1.02	19.00	258	.04	.04	.00	119.
1.01	19.10	115	.00	.00	.00	6.	1.02	19.10	259	.04	.04	.00	91.
1.01	19.20	116	.00	.00	.00	5.	1.02	19.20	260	.04	.04	.00	78.
1.01	19.30	117	.00	.00	.00	4.	1.02	19.30	261	.04	.04	.00	69.
1.01	19.40	118	.00	.00	.00	3.	1.02	19.40	262	.04	.04	.00	59.
1.01	19.50	119	.00	.00	.00	3.	1.02	19.50	263	.04	.04	.00	48.
1.01	20.00	120	.00	.00	.00	3.	1.02	20.00	264	.04	.04	.00	46.
1.01	20.10	121	.00	.00	.00	3.	1.02	20.10	265	.04	.04	.00	45.
1.01	20.20	122	.00	.00	.00	3.	1.02	20.20	266	.04	.04	.00	42.
1.01	20.30	123	.00	.00	.00	3.	1.02	20.30	267	.04	.04	.00	41.
1.01	20.40	124	.00	.00	.00	3.	1.02	20.40	268	.04	.04	.00	41.
1.01	20.50	125	.00	.00	.00	3.	1.02	20.50	269	.04	.04	.00	40.
1.01	21.00	126	.00	.00	.00	3.	1.02	21.00	270	.04	.04	.00	40.
1.01	21.10	127	.00	.00	.00	3.	1.02	21.10	271	.04	.04	.00	40.
1.01	21.20	128	.00	.00	.00	3.	1.02	21.20	272	.04	.04	.00	40.

1.01	19.50	119	.00	.00	.00	3.	1.02	19.50	263	.04	.04	.00	4C.
1.01	20.00	120	.00	.00	.00	3.	1.02	20.00	264	.04	.04	.00	4C.
1.01	20.10	121	.00	.00	.00	3.	1.02	20.10	265	.04	.04	.00	4C.
1.01	20.20	122	.00	.00	.00	3.	1.02	20.20	266	.04	.04	.00	4C.
1.01	20.30	123	.00	.00	.00	3.	1.02	20.30	267	.04	.04	.00	4C.
1.01	20.40	124	.00	.00	.00	3.	1.02	20.40	268	.04	.04	.00	4C.
1.01	20.50	125	.00	.00	.00	3.	1.02	20.50	269	.04	.04	.00	4C.
1.01	21.00	126	.00	.00	.00	3.	1.02	21.00	270	.04	.04	.00	4C.
1.01	21.10	127	.00	.00	.00	3.	1.02	21.10	271	.04	.04	.00	4C.
1.01	21.20	128	.00	.00	.00	3.	1.02	21.20	272	.04	.04	.00	4C.
1.01	21.30	129	.00	.00	.00	3.	1.02	21.30	273	.04	.04	.00	4C.
1.01	21.40	130	.00	.00	.00	3.	1.02	21.40	274	.04	.04	.00	4C.
1.01	21.50	131	.00	.00	.00	3.	1.02	21.50	275	.04	.04	.00	4C.
1.01	22.00	132	.00	.00	.00	3.	1.02	22.00	276	.04	.04	.00	4C.
1.01	22.10	133	.00	.00	.00	3.	1.02	22.10	277	.04	.04	.00	4C.
1.01	22.20	134	.00	.00	.00	3.	1.02	22.20	278	.04	.04	.00	4C.
1.01	22.30	135	.00	.00	.00	3.	1.02	22.30	279	.04	.04	.00	4C.
1.01	22.40	136	.00	.00	.00	3.	1.02	22.40	280	.04	.04	.00	4C.
1.01	22.50	137	.00	.00	.00	3.	1.02	22.50	281	.04	.04	.00	4C.
1.01	23.00	138	.00	.00	.00	3.	1.02	23.00	282	.04	.04	.00	4C.
1.01	23.10	139	.00	.00	.00	3.	1.02	23.10	283	.04	.04	.00	4C.
1.01	23.20	140	.00	.00	.00	3.	1.02	23.20	284	.04	.04	.00	4C.
1.01	23.30	141	.00	.00	.00	3.	1.02	23.30	285	.04	.04	.00	4C.
1.01	23.40	142	.00	.00	.00	3.	1.02	23.40	286	.04	.04	.00	4C.
1.01	23.50	143	.00	.00	.00	3.	1.02	23.50	287	.04	.04	.00	4C.
1.02	0.	144	.00	.00	.00	3.	1.03	0.	288	.04	.04	.00	4C.
									SUM	36.40	34.80	1.60	3215C.
										925.11	884.11	41.11	911.921

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1670.	662.	214.	112.	32167.
CMS	47.	19.	6.	3.	911.
INCHES		25.67	33.15	34.63	34.63
MM		652.09	842.06	879.67	879.67
AC-FT		328.	424.	443.	443.
THOUS CU M		405.	523.	547.	547.

HYDROGRAPH AT STA QIN-1 FOR PLAN 1, RTIO 1

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	3.	4.	4.	5.	5.
6.	7.	7.	8.	9.	9.	10.	11.	12.	13.
13.	14.	16.	23.	35.	45.	47.	42.	35.	29.
25.	22.	21.	19.	18.	17.	16.	16.	15.	13.
10.	8.	5.	4.	3.	2.	2.	2.	2.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	3.	5.	7.	9.	10.
10.	11.	11.	11.	11.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
19.	18.	27.	39.	43.	48.	51.	53.	54.	55.
56.	56.	57.	57.	57.	57.	57.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	59.
59.	59.	59.	59.	59.	59.	64.	80.	107.	136.
							334	260	249.

Output Summary
Various PMF Events
Lower Valle Mines Dam
MO 30439

B8

SUB-AREA RUNOFF COMPUTATION

LOWER VALLES MINE DAM(EARTH) INFLOW COMPUTATION, PMF RATIO FLOODS.

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
Q-IN2	0	-0	-0	-0	-0	1	-0	-0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.17	-0.	.17	1.00	-0.	-0	-0	-0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.	28.00	102.00	120.00	130.00	140.00	-0.	-0.

LOSS DATA

LKOPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
-0	-0.	-0.	1.00	-0.	-0.	1.00	-1.00	-87.00	-0.	.06

CURVE NO = -87.00 WETNESS = -1.00 EFFECT CN = 87.00

UNIT HYDROGRAPH DATA

TC= -0. LAG= .56

RECESSION DATA

STRTQ= -1.00 QRCSN= -.05 RTIOR= 9.00

UNIT HYDROGRAPH 19 END OF PERIOD ORDINATES, TC= -0. HOURS, LAG= .56 VOL= 1.00

20.	84.	116.	127.	110.	79.	49.	32.	21.	14.
9.	6.	4.	3.	2.	1.	1.	0.	0.	

END-OF-PERIOD FLOW

NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.10	1	.00	.00	.00	0.	1.02	.10	145	.03	.02	.00	2.
1.01	.20	2	.00	.00	.00	0.	1.02	.20	146	.03	.02	.00	4.
1.01	.30	3	.00	.00	.00	0.	1.02	.30	147	.03	.02	.00	6.
1.01	.40	4	.00	.00	.00	0.	1.02	.40	148	.03	.02	.00	7.
1.01	.50	5	.00	.00	.00	0.	1.02	.50	149	.03	.02	.00	11.
1.01	1.00	6	.00	.00	.00	0.	1.02	1.00	150	.03	.03	.00	12.
1.01	1.10	7	.00	.00	.00	0.	1.02	1.10	151	.03	.03	.00	14.
1.01	1.20	8	.00	.00	.00	0.	1.02	1.20	152	.03	.03	.00	15.
1.01	1.30	9	.00	.00	.00	0.	1.02	1.30	153	.03	.03	.00	16.
1.01	1.40	10	.00	.00	.00	0.	1.02	1.40	154	.03	.03	.00	16.
1.01	1.50	11	.00	.00	.00	0.	1.02	1.50	155	.03	.03	.00	16.
1.01	2.00	12	.00	.00	.00	0.	1.02	2.00	156	.03	.03	.00	16.
1.01	2.10	13	.00	.00	.00	0.	1.02	2.10	157	.03	.03	.00	16.
1.01	2.20	14	.00	.00	.00	0.	1.02	2.20	158	.03	.03	.00	17.
1.01	2.30	15	.00	.00	.00	0.	1.02	2.30	159	.03	.03	.00	17.
1.01	2.40	16	.00	.00	.00	0.	1.02	2.40	160	.03	.03	.00	17.
1.01	2.50	17	.00	.00	.00	0.	1.02	2.50	161	.03	.03	.00	17.
1.01	3.00	18	.00	.00	.00	0.	1.02	3.00	162	.03	.03	.00	17.
1.01	3.10	19	.00	.00	.00	0.	1.02	3.10	163	.03	.03	.00	17.
1.01	3.20	20	.00	.00	.00	0.	1.02	3.20	164	.03	.03	.00	17.
1.01	3.30	21	.00	.00	.00	0.	1.02	3.30	165	.03	.03	.00	17.
1.01	3.40	22	.00	.00	.00	0.	1.02	3.40	166	.03	.03	.00	17.
1.01	3.50	23	.00	.00	.00	0.	1.02	3.50	167	.03	.03	.00	17.
1.01	4.00	24	.00	.00	.00	0.	1.02	4.00	168	.03	.03	.00	17.
1.01	4.10	25	.00	.00	.00	0.	1.02	4.10	169	.03	.03	.00	17.
1.01	4.20	26	.00	.00	.00	0.	1.02	4.20	170	.03	.03	.00	17.
1.01	4.30	27	.00	.00	.00	0.	1.02	4.30	171	.03	.03	.00	17.
1.01	4.40	28	.00	.00	.00	0.	1.02	4.40	172	.03	.03	.00	17.
1.01	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.	1.02	4.50	173	.03	.03	.00	17.

Output Summary
Various PMF Events
Lower Valle Mines Dam
MO 30439

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Output Summary
Various PMF Events
Lower Valle Mines Dam
MO 30439
BIO

1.01	4.30	27	.00	.00	.00	0.	1.02	4.30	171	.03	.03	.00	17.
1.01	4.40	28	.00	.00	.00	0.	1.02	4.40	172	.03	.03	.00	17.
1.01	4.50	29	.00	.00	.00	0.	1.02	4.50	173	.03	.03	.00	17.
1.01	5.00	30	.00	.00	.00	0.	1.02	5.00	174	.03	.03	.00	17.
1.01	5.10	31	.00	.00	.00	0.	1.02	5.10	175	.03	.03	.00	17.
1.01	5.20	32	.00	.00	.00	0.	1.02	5.20	176	.03	.03	.00	17.
1.01	5.30	33	.00	.00	.00	0.	1.02	5.30	177	.03	.03	.00	17.
1.01	5.40	34	.00	.00	.00	0.	1.02	5.40	178	.03	.03	.00	17.
1.01	5.50	35	.00	.00	.00	0.	1.02	5.50	179	.03	.03	.00	17.
1.01	6.00	36	.00	.00	.00	0.	1.02	6.00	180	.03	.03	.00	17.
1.01	6.10	37	.01	.00	.01	0.	1.02	6.10	181	.13	.12	.01	19.
1.01	6.20	38	.01	.00	.01	0.	1.02	6.20	182	.13	.12	.01	20.
1.01	6.30	39	.01	.00	.01	0.	1.02	6.30	183	.13	.12	.01	20.
1.01	6.40	40	.01	.00	.01	0.	1.02	6.40	184	.13	.12	.01	20.
1.01	6.50	41	.01	.00	.01	0.	1.02	6.50	185	.13	.12	.01	20.
1.01	7.00	42	.01	.00	.01	0.	1.02	7.00	186	.13	.12	.01	20.
1.01	7.10	43	.01	.00	.01	0.	1.02	7.10	187	.13	.12	.01	20.
1.01	7.20	44	.01	.00	.01	0.	1.02	7.20	188	.13	.12	.01	20.
1.01	7.30	45	.01	.00	.01	0.	1.02	7.30	189	.13	.12	.01	20.
1.01	7.40	46	.01	.00	.01	0.	1.02	7.40	190	.13	.12	.01	20.
1.01	7.50	47	.01	.00	.01	0.	1.02	7.50	191	.13	.12	.01	20.
1.01	8.00	48	.01	.00	.01	0.	1.02	8.00	192	.13	.12	.01	20.
1.01	8.10	49	.01	.00	.01	0.	1.02	8.10	193	.13	.12	.01	20.
1.01	8.20	50	.01	.00	.01	0.	1.02	8.20	194	.13	.12	.01	20.
1.01	8.30	51	.01	.00	.01	0.	1.02	8.30	195	.13	.12	.01	21.
1.01	8.40	52	.01	.00	.01	0.	1.02	8.40	196	.13	.12	.01	21.
1.01	8.50	53	.01	.00	.01	0.	1.02	8.50	197	.13	.12	.01	21.
1.01	9.00	54	.01	.00	.01	0.	1.02	9.00	198	.13	.12	.01	21.
1.01	9.10	55	.01	.00	.01	0.	1.02	9.10	199	.13	.12	.01	22.
1.01	9.20	56	.01	.00	.01	0.	1.02	9.20	200	.13	.12	.01	22.
1.01	9.30	57	.01	.00	.01	0.	1.02	9.30	201	.13	.13	.00	22.
1.01	9.40	58	.01	.00	.01	0.	1.02	9.40	202	.13	.13	.00	22.
1.01	9.50	59	.01	.00	.01	0.	1.02	9.50	203	.13	.13	.00	22.
1.01	10.00	60	.01	.00	.01	0.	1.02	10.00	204	.13	.13	.00	22.
1.01	10.10	61	.01	.00	.01	0.	1.02	10.10	205	.13	.13	.00	22.
1.01	10.20	62	.01	.00	.01	0.	1.02	10.20	206	.13	.13	.00	22.
1.01	10.30	63	.01	.00	.01	1.	1.02	10.30	207	.13	.13	.00	23.
1.01	10.40	64	.01	.00	.01	1.	1.02	10.40	208	.13	.13	.00	23.
1.01	10.50	65	.01	.00	.01	1.	1.02	10.50	209	.13	.13	.00	23.
1.01	11.00	66	.01	.00	.01	1.	1.02	11.00	210	.13	.13	.00	23.
1.01	11.10	67	.01	.00	.01	1.	1.02	11.10	211	.13	.13	.00	23.
1.01	11.20	68	.01	.00	.01	1.	1.02	11.20	212	.13	.13	.00	23.
1.01	11.30	69	.01	.00	.01	1.	1.02	11.30	213	.13	.13	.00	23.
1.01	11.40	70	.01	.00	.01	1.	1.02	11.40	214	.13	.13	.00	23.
1.01	11.50	71	.01	.00	.01	1.	1.02	11.50	215	.13	.13	.00	23.
1.01	12.00	72	.01	.00	.01	1.	1.02	12.00	216	.13	.13	.00	23.
1.01	12.10	73	.03	.01	.03	1.	1.02	12.10	217	.44	.43	.01	69.
1.01	12.20	74	.03	.01	.03	2.	1.02	12.20	218	.44	.43	.01	109.
1.01	12.30	75	.03	.01	.02	3.	1.02	12.30	219	.44	.43	.01	144.
1.01	12.40	76	.03	.01	.02	4.	1.02	12.40	220	.44	.43	.01	173.
1.01	12.50	77	.03	.01	.02	4.	1.02	12.50	221	.44	.43	.01	217.
1.01	13.00	78	.03	.01	.02	5.	1.02	13.00	222	.44	.44	.01	242.
1.01	13.10	79	.04	.02	.02	6.	1.02	13.10	223	.53	.52	.01	254.
1.01	13.20	80	.04	.02	.02	7.	1.02	13.20	224	.53	.52	.01	270.
1.01	13.30	81	.04	.02	.02	8.	1.02	13.30	225	.53	.52	.01	291.
1.01	13.40	82	.04	.02	.02	9.	1.02	13.40	226	.53	.52	.01	307.
1.01	13.50	83	.04	.02	.02	10.	1.02	13.50	227	.53	.53	.01	320.
1.01	14.00	84	.04	.02	.02	11.	1.02	14.00	228	.53	.53	.00	329.
1.01	14.10	85	.05	.03	.02	12.	1.02	14.10	229	.66	.66	.01	339.
1.01	14.20	86	.05	.03	.02	13.	1.02	14.20	230	.66	.66	.01	350.
1.01	14.30	87	.05	.03	.02	14.	1.02	14.30	231	.66	.66	.00	367.
1.01	14.40	88	.05	.03	.02	15.	1.02	14.40	232	.66	.66	.00	380.
1.01	14.50	89	.05	.03	.02	17.	1.02	14.50	233	.66	.66	.00	402.

1.	14.49	88	.05	.03	.02	19.	1.02	14.40	232	.66	.66	.66	3[illegible].
1.01	14.50	89	.05	.03	.02	17.	1.02	14.50	233	.66	.66	.00	4[illegible].
1.01	15.00	90	.05	.03	.02	18.	1.02	15.00	234	.66	.66	.00	4[illegible].
1.01	15.10	91	.05	.03	.02	19.	1.02	15.10	235	.60	.60	.00	4[illegible].
1.01	15.20	92	.08	.05	.03	20.	1.02	15.20	236	1.01	1.00	.01	4[illegible].
1.01	15.30	93	.14	.10	.04	22.	1.02	15.30	237	1.81	1.81	.01	4[illegible].
1.01	15.40	94	.35	.26	.09	31.	1.02	15.40	238	4.53	4.52	.02	6[illegible].
1.01	15.50	95	.10	.08	.02	45.	1.02	15.50	239	1.31	1.31	.00	6[illegible].
1.01	16.00	96	.06	.05	.01	60.	1.02	16.00	240	.81	.80	.00	11[illegible].
1.01	16.10	97	.05	.04	.01	64.	1.02	16.10	241	.62	.62	.00	11[illegible].
1.01	16.20	98	.05	.04	.01	60.	1.02	16.20	242	.62	.62	.00	10[illegible].
1.01	16.30	99	.05	.04	.01	51.	1.02	16.30	243	.62	.62	.00	8[illegible].
1.01	16.40	100	.05	.04	.01	42.	1.02	16.40	244	.62	.62	.00	7[illegible].
1.01	16.50	101	.05	.04	.01	36.	1.02	16.50	245	.62	.62	.00	6[illegible].
1.01	17.00	102	.05	.04	.01	32.	1.02	17.00	246	.62	.62	.00	5[illegible].
1.01	17.10	103	.04	.03	.01	30.	1.02	17.10	247	.49	.49	.00	4[illegible].
1.01	17.20	104	.04	.03	.01	28.	1.02	17.20	248	.49	.49	.00	4[illegible].
1.01	17.30	105	.04	.03	.01	26.	1.02	17.30	249	.49	.49	.00	4[illegible].
1.01	17.40	106	.04	.03	.01	24.	1.02	17.40	250	.49	.49	.00	3[illegible].
1.01	17.50	107	.04	.03	.01	23.	1.02	17.50	251	.49	.49	.00	3[illegible].
1.01	18.00	108	.04	.03	.01	22.	1.02	18.00	252	.49	.49	.00	3[illegible].
1.01	18.10	109	.00	.00	.00	21.	1.02	18.10	253	.04	.04	.00	3[illegible].
1.01	18.20	110	.00	.00	.00	19.	1.02	18.20	254	.04	.04	.00	2[illegible].
1.01	18.30	111	.00	.00	.00	15.	1.02	18.30	255	.04	.04	.00	2[illegible].
1.01	18.40	112	.00	.00	.00	12.	1.02	18.40	256	.04	.04	.00	1[illegible].
1.01	18.50	113	.00	.00	.00	8.	1.02	18.50	257	.04	.04	.00	1[illegible].
1.01	19.00	114	.00	.00	.00	6.	1.02	19.00	258	.04	.04	.00	[illegible].
1.01	19.10	115	.00	.00	.00	5.	1.02	19.10	259	.04	.04	.00	[illegible].
1.01	19.20	116	.00	.00	.00	4.	1.02	19.20	260	.04	.04	.00	[illegible].
1.01	19.30	117	.00	.00	.00	3.	1.02	19.30	261	.04	.04	.00	[illegible].
1.01	19.40	118	.00	.00	.00	3.	1.02	19.40	262	.04	.04	.00	[illegible].
1.01	19.50	119	.00	.00	.00	2.	1.02	19.50	263	.04	.04	.00	[illegible].
1.01	20.00	120	.00	.00	.00	2.	1.02	20.00	264	.04	.04	.00	[illegible].
1.01	20.10	121	.00	.00	.00	2.	1.02	20.10	265	.04	.04	.00	[illegible].
1.01	20.20	122	.00	.00	.00	2.	1.02	20.20	266	.04	.04	.00	[illegible].
1.01	20.30	123	.00	.00	.00	2.	1.02	20.30	267	.04	.04	.00	[illegible].
1.01	20.40	124	.00	.00	.00	2.	1.02	20.40	268	.04	.04	.00	[illegible].
1.01	20.50	125	.00	.00	.00	2.	1.02	20.50	269	.04	.04	.00	[illegible].
1.01	21.00	126	.00	.00	.00	2.	1.02	21.00	270	.04	.04	.00	[illegible].
1.01	21.10	127	.00	.00	.00	2.	1.02	21.10	271	.04	.04	.00	[illegible].
1.01	21.20	128	.00	.00	.00	2.	1.02	21.20	272	.04	.04	.00	[illegible].
1.01	21.30	129	.00	.00	.00	2.	1.02	21.30	273	.04	.04	.00	[illegible].
1.01	21.40	130	.00	.00	.00	2.	1.02	21.40	274	.04	.04	.00	[illegible].
1.01	21.50	131	.00	.00	.00	2.	1.02	21.50	275	.04	.04	.00	[illegible].
1.01	22.00	132	.00	.00	.00	2.	1.02	22.00	276	.04	.04	.00	[illegible].
1.01	22.10	133	.00	.00	.00	2.	1.02	22.10	277	.04	.04	.00	[illegible].
1.01	22.20	134	.00	.00	.00	2.	1.02	22.20	278	.04	.04	.00	[illegible].
1.01	22.30	135	.00	.00	.00	2.	1.02	22.30	279	.04	.04	.00	[illegible].
1.01	22.40	136	.00	.00	.00	2.	1.02	22.40	280	.04	.04	.00	[illegible].
1.01	22.50	137	.00	.00	.00	2.	1.02	22.50	281	.04	.04	.00	[illegible].
1.01	23.00	138	.00	.00	.00	2.	1.02	23.00	282	.04	.04	.00	[illegible].
1.01	23.10	139	.00	.00	.00	2.	1.02	23.10	283	.04	.04	.00	[illegible].
1.01	23.20	140	.00	.00	.00	2.	1.02	23.20	284	.04	.04	.00	[illegible].
1.01	23.30	141	.00	.00	.00	2.	1.02	23.30	285	.04	.04	.00	[illegible].
1.01	23.40	142	.00	.00	.00	2.	1.02	23.40	286	.04	.04	.00	[illegible].
1.01	23.50	143	.00	.00	.00	2.	1.02	23.50	287	.04	.04	.00	[illegible].
1.02	0.	144	.00	.00	.00	2.	1.03	0.	288	.04	.04	.00	[illegible].
									SUM	36.40	34.77	1.63	22[illegible].
										(925.1(	883.1(	41.1(	644.26(

Output Summary
Various PMF Events
Lower Valle Mines Dam
MO 30439
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	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1158.	469.	151.	79.	22752.
CMS	33.	13.	4.	2.	644.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO APPLIED TO FLOWS: RATIO 1	RATIO 2
				.50	1.00
HYDROGRAPH AT	DAM-1	.24	1	839.	1670.
		(.62)		(23.64)	(47.29)
ROUTED TO	DAM-1	.24	1	1299.	1319.
		(.62)		(36.77)	(37.23)
HYDROGRAPH AT	D-IN2	.17	1	979.	1190.
		(.44)		(26.39)	(32.79)
2 COMBINED	D-IN2	.41	1	1919.	2294.
		(1.06)		(37.23)	(65.10)
ROUTED TO	DAM2	.41	1	1116.	2301.
		(1.06)		(31.61)	(65.16)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	782.50	782.50	789.20
STORAGE	54.	54.	78.
OUTFLOW	0.	0.	636.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	789.78	.58	83.	1116.	2.33	40.33	0.
1.00	786.51	1.31	91.	2301.	5.67	40.33	0.

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Output Summary
Various PMF Events
Lower Valle Mines Dam
MO 30439

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .08	RATIO 2 .09	RATIO 3 .10	RATIO 4 .11
HYDROGRAPH AT	U1N-1	.24	1	134.	150.	167.	184.
		(.62)		(3.78)	(4.26)	(4.73)	(5.20)
ROUTED TO	DAM-1	.24	1	0.	0.	1.	1268.
		(.62)		(0.)	(0.)	(.01)	(35.91)
HYDROGRAPH AT	U-IN2	.17	1	93.	104.	116.	127.
		(.44)		(2.62)	(2.95)	(3.28)	(3.61)
2 COMBINED	U-IN2	.41	1	93.	104.	116.	1272.
		(1.06)		(2.62)	(2.95)	(3.28)	(36.02)
ROUTED TO	DAM2	.41	1	91.	63.	74.	1079.
		(1.06)		(1.44)	(1.78)	(2.10)	(30.54)

SUMMARY OF DAM SAFETY ANALYSIS
(LOWER VALLE MINES EARTH DAM)

PLAN 1

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	782.50	782.50	789.20
STORAGE	54.	54.	78.
OUTFLOW	0.	0.	636.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.08	783.54	0.	63.	91.	0.	40.83	0.
.09	783.62	0.	63.	63.	0.	40.67	0.
.10	783.69	0.	64.	74.	0.	40.67	0.
.11	789.73	.93	83.	1079.	.67	44.17	0.

Output Summary
Various PMF Events
Lower Valle Mines Dam
MO 30439
Bia